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ABSTRACT

Presented is an industrial arts curriculum guide for woodworking which developed out of a 3 year program designed to meet the unmet vocational education needs of visually impaired students enrolled in junior high, secondary, and community colleges in a five county region of California, and to provide inservice training to regular vocational education teachers and counselors working with blind students. Four chapters introduce travel techniques used in the shop, orientation to the shop, measuring devices, and hand tools, respectively. Eight chapters present the principal machines found in school workshops in terms of description, safety, adaptations, orientation, exceptions, operation, maintenance, and references. Considered are the circular saw, the drill press, the radial arm saw, the wood lathe, sanders, band saw and scroll saw, the planer and joiner, and electric hand tools. Two final chapters instruct in sanding the project and finishing the project. For other program documents see EC 051 131 through EC 051 133. (DB)

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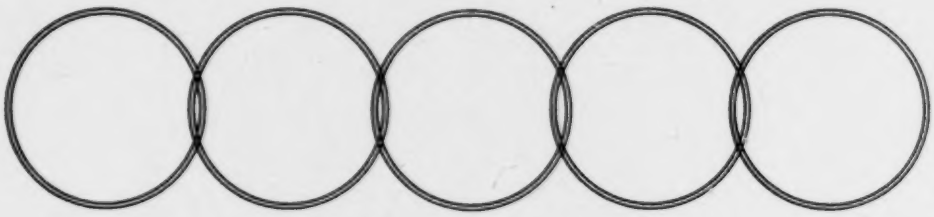

5-COUNTY

VOCATIONAL SKILLS TRAINING PROGRAM FOR THE VISUALLY HANDICAPPED

• industrial arts curriculum guide

Santa Cruz County Office of Education

Richard R. Fickel, Superintendent

701 Ocean Street Santa Cruz, California 95060

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A FIVE COUNTY

VOCATIONAL SKILLS TRAINING PROGRAM FOR THE BLIND

WOODWORKING GUIDE FOR VISUALLY HANDICAPPED STUDENTS

by

Wayne Gaver
rade and Industrial Specialist
Vocational Skills Training Program

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THE SANTA CRUZ COUNTY
OFFICE OF EDUCATION
Santa Cruz, California 95060

DR. RICHARD R. FICKEL, SUPERINTENDENT
June, 1972

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FOREWORD

The Santa Cruz County Vocational Skills project for blind and partially sighted minors was authorized with the passing of S. B. 632 (Grunsky) in 1969. In concert with the County Superintendents of San Mateo, Santa Clara, San Benito, and Monterey Counties, a regional program of supplemental in-service and pupil instruction was submitted to the Vocational Education Section, State Department of Education, in November, 1969. In the proposal document, the major thrust of the project was described as: (1) meeting the unmet vocational education needs of visually handicapped pupils enrolled in junior high, secondary, and community colleges in the five-county region, and (2) providing in-service training to regular vocational education teachers and work experience counselors assigned to schools where blind students are enrolled.

The program was funded for a three year period from 1969 to 1972 through the Vocational Education Act of 1964. Vocational areas emphasized were technical and industrial arts, home-making, and work experience. This three year project has also included an information and dissemination component where the project staff have conducted over a dozen workshops throughout the State in conjunction with the Vocational Education Section of the Division of Special Education, State Department of Education. Many Department of Rehabilitation counselors for the blind participated in the workshops.

Vocational Education teachers who had not previously had the opportunity of working with visually handicapped students, have had, through this program, the opportunity of being trained in the skills required to broaden each child's vocational potential through the use of tools, equipment, and the development of skills associated with homemaking and technical industrial occupations, as well as work experience.

This Curriculum Guide will provide counselors for the blind, vocational education teachers, and teachers of the visually handicapped with specific guidelines demonstrating the techniques required for the instruction of visually handicapped pupils in selected occupational courses and counseling, as well as work training.

DR. LAWRENCE A. EDLER, Director
Secondary Programs

RICHARD D. STRUCK, Director
Programs for Exceptional Children
& Adults & Pupil Personnel Services

PREFACE

The Santa Cruz County Board of Education and County Superintendent and staff are committed to providing students, in terms of individual capability notwithstanding handicaps, the opportunities for vocational development which will prepare them to find their place in society as productive participating members.

The purpose of this exemplary project, Vocational Skills for the Blind and Partially Sighted, has been to provide vocational skill training and counseling to blind and partially sighted students in the five-county area of Monterey, San Benito, San Mateo, Santa Clara, and Santa Cruz Counties.

An indication of the cooperative effort necessary to provide these services and experiences is the eagerness and participation of the superintendents, teachers, and employees of the five counties together with state consultants and rehabilitation counselors. The efforts and results have been most rewarding.

RICHARD R. FICKEL, SUPERINTENDENT
Santa Cruz County Office of Education
Santa Cruz, California

INTRODUCTION

The curriculum guide for woodworking was compiled to help the blind or visually handicapped to learn how to work safely in the woodshop. It was assumed that the student knows little of the various machines and procedures; so all of the guide is not pertinent to instructors or people with knowledge of woodworking

The guide was divided into sections on each of the principal machines found in school woodshops Each section follows a basic format which makes it easy to find information on a particular subject. The section divisions are:

A. Description (of the machine and the principle of operation)

B. Safety (both general and specific to the machine)

C. Adaptations (this is aimed at the Vocational Education teacher to make operation easier for the student)

D. Orientation (to the machine in orderly steps)

E. Exceptions (items that are different on different machines)

F. Operation (the non-visual method to operation)

G. Maintenance (the specific requirements of the machine for continual smooth operation)

H. References (used in compiling the information and for additional information about the machine)

The techniques described are those which have been used and developed during the past two and one-half years of itinerant teaching of the visually handicapped They are to be used as suggestions or illustrations. If you have developed techniques other than those

described, keep in mind that there are always several ways of accomplishing a task.

ACKNOWLEDGMENTS

The author gratefully acknowledges those persons who have submitted ideas and information that have been used in compiling this curriculum guide, specifically the staff and students of the Western Blind Rehabilitation Center in Menlo Park, California, and the staff and students of the schools served in the five counties covered by the Vocational Skills Training Program: Monterey, San Benito, San Mateo, Santa Clara, and Santa Cruz Counties.

Wayne Gaver
Trade and Industrial Specialist
Vocational Skills Training Program

CHAPTER I

TRAVEL TECHNIQUES USED IN SHOP

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CHAPTER I

TRAVEL TECHNIQUES USED IN SHOP

A. Hand and Forearm Technique

This technique is useful for detecting obstacles when getting around unaided, such as a desk or other piece of furniture which may have been rearranged, or when in unfamiliar surroundings, as a new shop.

The arm is held at shoulder height parallel to the floor, across the front of the body. The upper arm is at obtuse angle to the remainder of the arm. The forearm is held so that the elbow makes an angle a little more than a right angle and the tips of the fingers are extended slightly beyond the shoulder. As the blind person walks, objects at shoulder level will be encountered by the hand. The time between the hand and body encounter will allow the person time to react and stop before the body hits the obstacle. This technique should be used whenever the person is moving about in unfamiliar surroundings and in familiar ones where there is potential obstruction such as doorways, etc.

For added protection in unfamiliar surroundings, a combination of the hand forearm technique mentioned above, and the lower cross-body technique discussed below, can be used.

B. The Lower Arm Technique

A person standing with his arms at his sides may bring either

of his hands to the midline in front of the body without bending the elbow. The hand is held a foot or so in front of the body with little finger outermost and the thumb toward the body. Holding the hand in this position will keep the person from jamming his thumb into some hard object and at the same time will allow the fingers to encounter an obstacle early enough to give the person time to react before bumping. A slight modification is permissible when objects below the level of fingertips are believed present, such as low tables or machinery. This may be accomplished by lowering the shoulder. This should not be a leaning forward of the entire body. Limitations of this method are: lower objects are not detected, one side of the body is left relatively unprotected and the face is open to bumps unless the raised upper forearm technique is used simultaneously. The student should be made aware of the limitation.

C. Trailing

On occasion, it is more desirable for a blind person to follow a wall, table edge, other line. The proper technique for doing this is to keep the arm straight to the elbow and move the hand along the wall so that it is about a foot ahead of the body at approximately the height of the hip. The person can walk along the wall not more than a foot away from it. The hand on the side near the wall is held with the fingers relaxed, palm down and thumb folded near the palm to protect it from being jammed into obstacles. The surface is touched lightly with the joints of the ring and little fingers. Contact is made with the side of each finger closest to the wall.

This method often may be used by recently blinded individuals, which may be the first successful attempt at independent travel Although blind people should not be dependent entirely on trailing as a means of mobility, they may want to use this as a means for tactual identification

D Use of Sighted Guide

The person being guided should grasp the guide firmly, generally just above the elbow on the side on which he intends to walk That is, the blind person would take the left arm with his right hand if he intended to walk on the left side of the guide He walks a half a step behind the guide so that he will have time to react to body movement of the guide The guide should walk at his normal pace unless there is a factor adversely affecting the pace of the blind person

The blind person should pay attention to the arm motions, since these movements tell what the guide is doing or is about to do The reason for grasping the arm above the elbow is to leave the guide's arm free to do whatever he needs to do with it, such as carry a bundle, open a door, or reach in his pocket A child might be allowed to take the arm just above the wrist in preference to holding hands

For ascending and descending stairs, the guide should pause slightly before beginning the ascent or descent This tells the follower to be alert for coming body motion that will let him know if the guide is doing something out of the ordinary Stairs should be approached at right angles so that the blind person does not get to them at the same time or ahead of the guide The same technique is used at

curbs, which might be considered a very short stairway.

The preceding was reprinted from Handbook for Teachers of the Visually Handicapped from the Instructional Materials Reference Center for Visually Handicapped Children, American Printing House for the Blind, 1839 Frankfort Avenue, Louisville, Kentucky, 40206.

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ORIENTATION TO THE SHOP

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CHAPTER II

ORIENTATION TO THE SHOP

Initial Investigation

The initial investigation of the shop should be made with a sighted guide. The following is a list of subjects to be covered.

A. A Verbal Description of the Shop (along with an examination of tactual map). (Note: See A, No. 10.)

1. Over-all size in feet
2. Walls encountered and pillars within shop
3. Machines
    a. How Many
    b. Size
    c. Danger area around
4. Wood rack
5. Project storage
6. Work benches
7. Tool storage cabinet
8. Main power switch
9. Exits
    a. Door
    b. Window
    c. Fire exits
10. Tactual map

The layout of the shop can be made on a piece of plywood It should include all the walls and pillars as well as the various machines, work benches, wood rack and exits It is handy to label in braille the various machines for later reference by students

B Guided Examination of Room

1 Cover the perimeter of the room Examine lightly all objects and machines encountered around the perimeter of the room. Where there is danger in tactual examination, disconnect power cord Guide will give a brief explanation of the machine and use

2. Cover the objects and machines in middle of room. Guide will give the relationship of the machines in the middle to each other and to the travel route from one side of the room.

C. Verbal Guidance to Principal Machines and Objects Used

From a planned starting point (usually a wall pillar close to the entrance door to the shop, called home base) guide will verbally direct the student to the principal work areas. The cross body and head protective positioning of hands is used by student Student is urged to remember the route in regards to direction and distance The route should be planned so as to avoid interfering with other students' work areas It should also be a safe route that will be clear all the time. Note: Whenever possible the route should be planned so that the student can trail along straight surfaces This minimizes the free walking

and the possibility of walking off line.

The location of all the machines should be learned, even though they are not all used. The machines and places to be learned are listed in the following suggested order:

a. Fire exits, windows, doors

b. Work bench

c. Tool storage cabinet

d. Face shield or safety goggle storage

e. Main power switch

f. Project storage (shop apron)

g. Wood rack - scrap box

h. Trash cans

i. Machines

j. Exhaust system switch

k. Glue table, clamp rack

l. Finish room or table

m. Clean-up tools, broom, dust pan, brushes.

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CHAPTER III

MEASURING DEVICES

Introduction

There are a number of ways that the visually handicapped can gain accuracy in measuring. The standard rules have been modified by the addition of either raised dots or by slotting for fingernails. Specially designed cast metal or plastic rulers are available. The main idea in picking a measuring device is to use the device that will lend itself easily to the particular job; then the user must become familiar with the device by continual use.

A few devices are described below.

A. American Foundation for the Blind Adaptations

1. AFB 12" Cast Aluminum Rule

This is a rigid, cast aluminum rule with the working edge notched for tactual reading at each 1/16" division. The divisions of 1/16", 1/8", 1/4", 1/2", and 1" are designated by notches which are increasingly longer as the fraction is longer. The even inch notches are quite long reaching from the edge of the ruler, across a sloping surface and to the opposite edge of the rule, and terminating with a brailled numeral. Because of so many notches this rule can be quite confusing if one is not familiar with it.

2. AFB Combination Square

This is the standard combination square with a brass strip

adapted to one edge The strip has a single dot at each 1/8" division, two dots at each 1/2" mark and 3 dots at each 1" mark. This square is good for measurements from the edge of boards and in to the middle up to 10" The reason being, the user can set the sliding cross member to the desired length and need only hold this tight to the edge of the work while the mark can be made with the other hand The use of a knife or scratch awl will lay out the mark accurately at the desired length.

3. AFB Aluminum Marking Gauge

The aluminum marking gauge is used for comparative measurements. It has a beam which is marked with graduations similar to the AFB 12" cast aluminum rule It has an aluminum head which can be set at any position on the beam, and locked with a thumbscrew. The head is set by placing the thumbnail in the appropriate notch and moving the head up to the thumbnail. The rule is especially useful for laying out lines parallel to the edge, as the scratch made by the small pin in the rule is slid along the work

4. AFB Adaptation of the Stanley Caliper Rule

This rule is useful for comparative purposes. It is generally thought of as used for measuring thickness of stock. The rule has one stationary jaw and a sliding jaw which has a raised dot scale. The stationary jaw has two raised dots on the face which serve as a zeroing index The dot on the stationary jaw which is closest to the face of the jaw, indicates outside measurement; the second dot is used for inside measurement. Inside

measurements are made by using the outside edges of the small ends of the two jaws, while outside measurements use the inside of the two jaws. Because of the looseness of the jaws, some find this tool hard to use on measurements much larger than an inch and a half.

5. AFB Threaded Rod Rules

a. Rotomatic

This is essentially a 3/8" threaded aluminum rod with 16 threads per inch and a threaded, rectangular, revolving head. The threaded rod has one side milled flat, and the other side milled flat except for every half inch which is left for quick locations of lengths. One problem with this is the time needed to set rod to proper length. (The revolving head having to be screwed the length of the rod.) The Rotomatic is available in six and twelve inch lengths.

b. Click-O Matic

This is the same as the above with the exception that the head is not revolving, but has a spring-loaded ball that clicks into each thread. This is handy for quick setting because the sixteenths can be counted from the closest half-inch. The Click-O Matic comes in twelve inch lengths and twelve-inch rods can be added for 24" or 36" rules.

c. Telescopic Click Rule

This rule is much like the Click-O-Matic in that it has a threaded rod which allows the rule to click into position at every 1/16 graduation. It also has raised graduations

at each 1/2". The threaded rod slides into the 7-5/8" aluminum housing and has a locking thumbscrew which slides in a slot on the stop of the rule. At the end of the housing, a head or shoulder 1/4" thick is positioned, which takes the place of the sliding head of the Click-O-Matic. Six inches back from the head, and placed at right angle to it, is another head on the housing which makes possible the taking of inside measurements from 6-1/4" to 12-1/2". Depth measurements up to 6" and outside measurements up to 12" can be taken accurately to 1/16" with this rule. The one- and two-foot extensions are also available for this rule, making it possible to measure up to 36" by 1/16".

B. Shopmade or Adapted Measuring Devices

1. 24" Folding Rule

A good rule for quick adaptation is the 24" folding rule. The rule is made of wood and marks can be burned into the face every 1/2" and on the edge every 1" with a woodburning pencil, a chisel, pocket knife, or a fine-tooth saw.

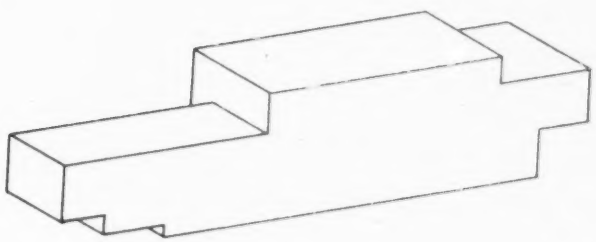
2. Steel Rules

Steel rules in 12", 24", or 36" lengths can be adapted for tactual reading by using a hacksaw and sawing notches on the edge of the rule. The spacing of the notches is arbitrary but one thing to remember is that the closer the notches are, the harder it is to read the rule.

3. Shopmade Gauge Block

A block can be cut to have all the common dimensions on it.

Here again it is left to the individual craftsman as to the size and shape of the block. One shape of a shopmade gauge block is suggested below; the dimensions are omitted, but the over-all length can be six or twelve inches.



Shopmade Gauge Block

C. Rules for Longer Measurement

1. The AFB has made available a 6' steel tape with raised dot adaptations. The first 6" section of the tape has a dot at each 1/8" graduation, two dots at each 1/2" and three dots at each 1" division. The second 6" section of the tape has one dot at each 1" position and two dots at the 12" position. From 12" to 24" the tape has a single dot at each 2" position and a double dot at the 24" position. From 24" to the end of the tape, there are single dots at each 6" position and double dots at each foot graduation.
2. The AFB also adapted the 25' Lufkin Steel tape for tactual

reading. The first 11' of the tape are marked with one raised dot at each inch and two raised dots at each one foot marking. The remainder of the tape has been marked with one dot at each foot interval, two dots at the 5', 15', and 25' positions, and three dots at the 10' and 20' positions.

D. References

1. Teaching Woodworking to Visually Handicapped Persons: An Instructor's Guide. Department of Health, Education, and Welfare, Washington, D. C., and University of Illinois, Urbana, Illinois. 1963.

2. Industrial Arts Woodworking (Second Edition). John L. Feirer. Charles A. Bennett Co., Inc., Peoria, Illinois. 1965.

CHAPTER IV

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CHAPTER IV

HAND TOOLS

A. Claw Hammer

1. Description

A claw hammer consists of the head and the handle. The head has the face on one end and the claw on the other. The face is the part used for driving nails, whereas the claw is used for extracting nails.

2. Use

When first using the claw hammer, it is a good idea to practice on a scrap piece of wood. The proper grip of the handle is to grasp it in your hand about an inch of two from the end of the handle; however, it is permissible to choke up on the handle or slide the hand closer to the head. This will enable you to control it easier. To start nailing, rest the point of the nail on the wood, and lightly tap to get it started into the wood. The strokes used should be even and of uniform pressure. The arm should pivot at the elbow using as little shoulder movement as possible. When the nail is started into the wood so it will stand on its own, stop and check it to see if it is standing straight up, as a nail started at an angle has little chance of

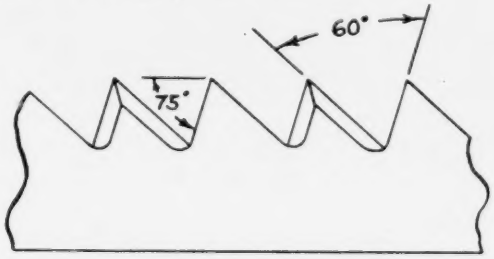
being driven home. Continue to drive the nail, taking care to strike directly down on the nail. If you should feel the hammer slide off to one side when the nail is struck, stop, and check to see if you have bent the nail over. The smaller penny nails can usually be straightened by hand, whereas the larger penny nails will either have to be pounded straight or pulled out and replaced.

B. Saws

1. Description

The saw is comprised of a handle and a blade. The handle is shaped to hold easily and to house the blade. The blade is the part in which the teeth are filed. The toe is the end of the blade opposite the handle. The heel is the portion of the blade nearest the handle. The back is the edge of the blade opposite the teeth. Saws are made with both straight and skew backs.

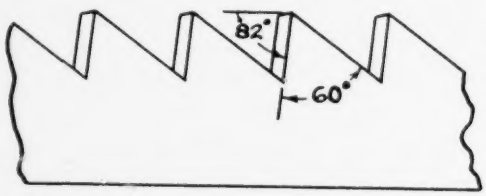
2. Crosscut Saw



A crosscut saw is considered an all-purpose saw, but it is especially designed to cut across the grain of the wood or at an angle to the grain. It is used to cut boards to length. The teeth of the saw cut both as a knife and as a chisel. The extreme points on either side of the saw score parallel lines.

As the action continues, the cutting edge on the inside of the teeth comes into contact with the wood, shearing it out of the kerf or the groove made by sawing.

3. Ripsaw

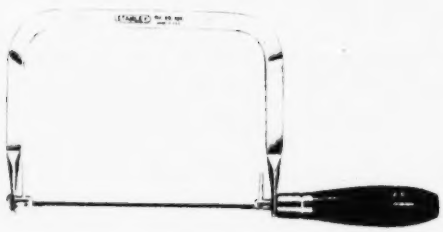


The ripsaw is used for cutting along or with the grain of the wood. It can be used to cut across the grain on wet or green lumber if used correctly. The teeth of a ripsaw are chisel-shaped. These teeth have a straight front and sever the fibers at one place only. They do not score either side of the cut.

4. Back Saw and Dovetail Saw

The back saw has fine crosscut teeth with a thin blade and a steel reinforced bar on the back. It is used for fine cutting or where a straight, even cut is required. The dovetail is similar to the back saw except it has a thinner blade and a straight handle. It can be used for cutting wood points as can the back saw.

5. Coping Saw



The coping saw has a narrow blade with rip teeth, which is held in a steel frame under tension. It is used to follow a curve. When using the coping saw you can scratch a line in the wood with a scratch awl, knife or stylus. The standard braille stylus which is used with a slate makes an excellent tool for scribing easy-to-follow lines. After the line is marked, clamp the wood in a vise so the line can be followed without cutting into anything else. Remember that the coping saw blade should be set up to cut on the pull stroke. Start cutting by lining up the blade to the line, pull lightly at first; stop ever so often to check how close you are to the line. Also check an inch in front of the blade to see which way to angle the cut. Where a long cut is to be made it is advisable to make relief cuts every five to eight inches so that the piece of wood will fall out when you have cut up to that point. This avoids having to back the saw out a long distance and possibly breaking the blade when reshifting the wood in the vise.

6. Use of Crosscut and Ripsaw

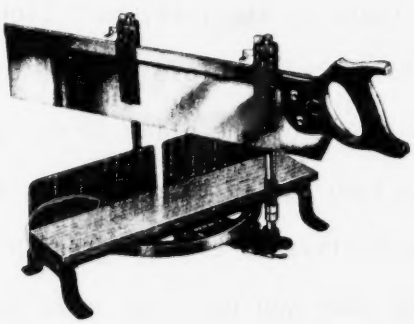
a. Be sure that you have marked the line to be sawed with a heavy scratch mark. The best procedure to start the saw is to place the left thumb-nail in the scratch hole mark

on the board and place the saw against the thumb-nail with the handle on the saw closest to the wood so that a long back stroke may be taken. Next, pull the saw backward across the area of the saw while guiding it against the guide or a try square. If you make two or three of these backward cuts before actually starting to saw you will experience less problems from the saw jumping off the mark to be cut. To aid in the sawing operation, the wood should be held firmly by means of a vise or clamp.

b. In order to insure a square cut it is suggested that you use a saw guide. The American Foundation for the Blind has available a saw guide. For those who wish to, a saw guide can be made in the shop.

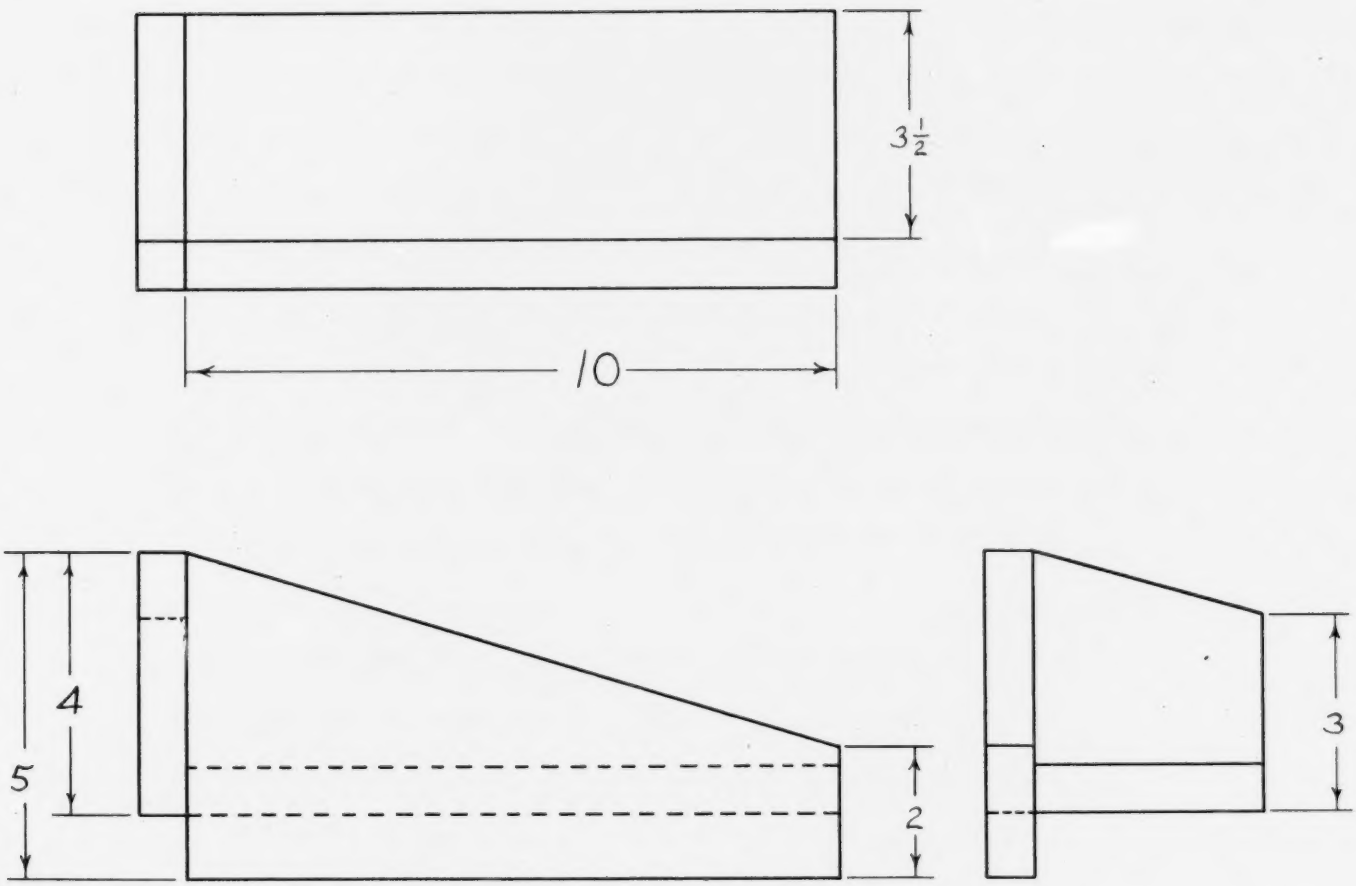
c. Plans for the saw guide are on page 23.

7. Mitre Box



a. Description

The mitre box is a jig which guides a fine-tooth crosscut saw in making accurate angle cuts. The saw slides in guides which may be set to certain predetermined angles without the use of other layout tools. These guides hold the saw in a vertical position at all times. A specially made



Saw Guide Plans

carbon steel back saw is used in the mitre box, differing from the conventional back saw only in length and width. It has a heavy rigid back, which stiffens the blade and rides in the mitre box guide. The frame of the mitre box holds the board to be cut. The saw guide has a catch which allows you to raise the saw and lock into position above your work. The saw guides are mounted on an iron or steel quadrant which is graduated into keys and numbered for sawing three through eight 12- to 24-sided figures. This quadrant can be adapted with brass extrusion pins to mark the popular angles used. Most mitre boxes cut from zero through 45 degrees right or left at intervals of 15 degrees.

b. Use

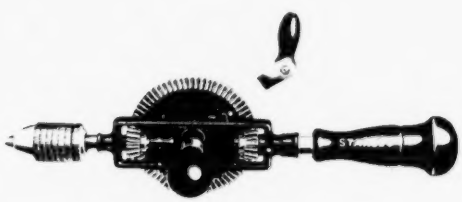
To position your work on the mitre box, you must first raise the saw and lock into position. Place your work on the frame up against the fence. Set the saw guide for the desired angle. Release the saw guide catches and allow the front edge of the saw to lightly rest on your work. Reposition your work so that the saw teeth are exactly lined up over your scratch mark. Hold the work down with your left hand using your fingers over the fence, and your thumb on the work. Saw using light strokes taking care not to bang the saw handle into the saw guides. Care must be taken, so as not to saw into the frame of the mitre box. Stops can be set up to eliminate this problem.

C. Drills

1. Selecting the Proper Tools to Cut a Hole

There are a number of hand tools available for drilling holes. The type of tool to be selected depends upon the diameter of the hole to be made. Small holes 1/32" to 1/8" can be made by a brad awl, automatic drill, or hand drill with a brad mounted in it. Holes 1/16" to 1/4" may be drilled with a hand drill. The plain bit brace is also available for use on holes this size and larger.

2. Hand Drills



a. Description

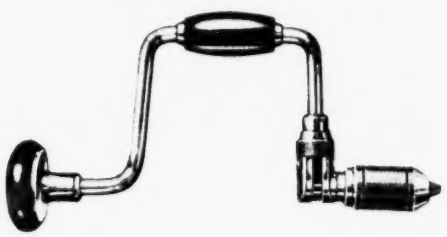
The hand drill consists of a handle, frame, crank and handle, and a chuck. The size of a hand drill depends on the chuck diameter opening. There are usually three sizes: o to 1/4 inch; o to 3/8 inch; and o to 1/2 inch.

b. Use

The drill bit is mounted in the hand drill by turning the hand drill upside down and holding stationary the crank handle and then screwing the chuck so that the jaws open wide enough to allow you to slip the bit into the chuck. Still holding the drill, crank, and handle with your left

hand tighten the chuck on the drill. Before drilling, make sure that you have marked the place where the hole is to be drilled with a scratch awl or other sharp object. Hold the drill upright with one hand and with the other hand put the end of the drill bit into the hole. Holding the drill as straight up as possible, crank the handle using even pressure down.

3. Plain Bit Brace



a. Description

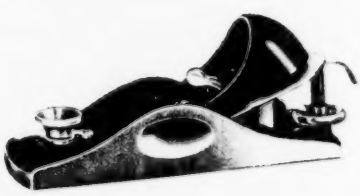
The bit brace uses the principle of the wheel and axle in creating its driving force. The pressure on the sling of the bow is in direct proportion to the force applied to cutters of the bit. This tool is so constructed that downward pressure may be applied on the boring tool by a constant revolving motion thus directing the cutting action. The principal parts of the bit brace are: the head, the steel bow, handle, chuck, and jaw. The head, made of Cocobolo, aluminum, or plastic, is fastened to the bow and turns freely on ball bearings. It is a control for direction and pressure. The steel bow forms the outer rim of the plain bit brace. It carries the power from the operator's hand to the chuck. This bow permits control for

continuous operation. The handle, made of Cocobolo, aluminum, or plastic, is fastened to the bow but turns freely on it. It is on the handle that the force is applied to turn the brace. The hardened steel jaws on the chuck are held in position by the use of a screw and wedge. Tightening the sleeve of the chuck forces the jaws to close. The chuck will rotate on ball bearings at the bow joint.

b. Use

The bit brace or bit stock is used for holding and driving all kinds of boring tools, screwdriver bits, dowel pointers, and counter sinks. After the bit is selected, the jaws of the bit must be opened to allow the bit to slide in. Rotate the bit slightly in the jaws to allow it to seat. Tighten the jaws firmly by holding the steel bow an rotating the chuck clockwise. The primary layout and use is the same as the hand tools above.

D. Planes



1. Description

All hand planes work on the principle of the cutting wedge. The principal parts of the plane are: the frame, the saw, adjusting nut, handle, plane iron, lateral adjusting lever, and

knob. The frame is the body of the plane and determines its size. It is usually made of a casting of gray iron or aluminum, sometimes of pressed steel. The bottom of the plane is called the sole and may be smooth or corrugated. The frog, made of cast iron, provides the angle to which the plane iron is held and positions it at the rear of the mouth. The lateral adjusting lever, made of pressed steel, is used to adjust for an even thickness of shaving. The adjusting nut, made of plastic or brass is used to increase or decrease the depth of the cut or thickness of shaving. The plane iron or cutter, made of the finest tool steel, is tempered and hardened and does the cutting. The plane iron cast, made of steel, is shaped to give thickness to the cutting edge and prevent chattering. It breaks the back of the shaving, causing it to curl, and prevent splitting or digging into the surface. It is attached to the plane iron with a cap screw. Knobs and handles are made of either plastic, cast aluminum, or wood. They are the means by which pressure is applied and direction is controlled.

2. Kinds of Planes

There are many different types of planes used in wood working. The following is a list of the five most common planes used.

a. Joiner planes are used to plane large surfaces and to join edges on long pieces. Like all members of the plane family except the block plane, the cutter is set at an angle of 45 degrees with the bevel facing down. They are 22 inches and 24 inches long.

b. Fore planes used for planing large surfaces and edges. They are 18 inches long and have a 2-3/8 inch cutter.

c. Jack planes are used to true edges and are commonly called all-purpose planes. They are the ones most commonly found in school wood shops. They are 14 inches and 15 inches long with cutters that are 2-3/8 inches wide.

d. Smooth planes are used for smoothing and finishing work. They are 7 inches, 8 inches, 9 inches, or 10 inches long.

e. Block planes are used for planing across the grain, such as in end grains. They differ from the preceding planes in that the cutter is set at an angle of 20 degrees with the bevel facing up. The lever cap is shaped to fit the hand, serving as a handle. They are 6 or 7 inches long.

3. Use of Hand Planes

Before using a plane, the plane iron should be checked for sharpness. This can be done by lightly rubbing your thumb across the face of the plane where the plane iron protrudes through the face. The lateral adjustment of the plane iron can also be checked by feeling across the cutting edge for an even protrusion through the face. This is done by using the same motion of your thumb as in checking for sharpness. If this protrusion is uneven, the lateral adjusting lever may be moved to the right or left to adjust for this. The thickness of the cut is determined by how much the plane iron protrudes through the face of the plane. This is set by first releasing the plane iron cap lever and then moving the plane iron up or down to the

desired thickness. When planing anything you must have both hands free to work the plane. To do this you must first clamp the wood in a vise so that no metal is close to the edge that you are going to plane. Grasp the plane, using one hand on the knob and the other on the handle. Rest the toe of the plane on the edge of the wood, then stroke across the wood using even pressure. Caution must be taken when planing wood with open grain, because planing against the grain will produce splintering or gouging. If, after the first plane stroke, excess surface roughness can be detected chances are that you are planing against the grain and the board should be planed in the opposite direction.

It is usually difficult to keep the plane perpendicular to the face of the material when planing edge or end grain. The common procedure is to carefully place the plane so that it is centered laterally over the board, and not tipped to either side before starting to plane. The index finger of the front hand is extended over the side of the plane and slid along the surface of the board as a guide to keep the front of the plane on the work.

If the above method is used and it is found that it is too hard to keep the board square, it is suggested that a guide be used. A guide can be made out of wood and attached to the side of the plane for increasing speed and accuracy and safety of good planing operation. The guide consists of a piece of wood glued to a piece of 1/4 inch plywood so that they overlap slightly.

To avoid the necessity of holding the guide firmly against the plane, a round head screw is fastened in the side of the block of wood. If much planing is done, it is suggested that a jointer gauge be purchased and attached to the side of the plane.

E. References

1. Teaching Woodworking to Visually Handicapped Persons. An Instructor's Guide. Department of Health, Education, and Welfare, Washington, D. C., and University of Illinois, Urbana, Illinois. 1963.

2. Woodworking Technology. Hammond, Donnelly, Harrod, Rayner (Second Edition). McKnight and McKnight Publishing Co., Bloomington, Illinois. 1961.

3. Industrial Arts Woodworking. John L. Feirer. (Second Edition) Charles A. Bennett Co., Inc., Peoria, Illinois. 1965.

CHAPTER V

CIRCULAR SAW

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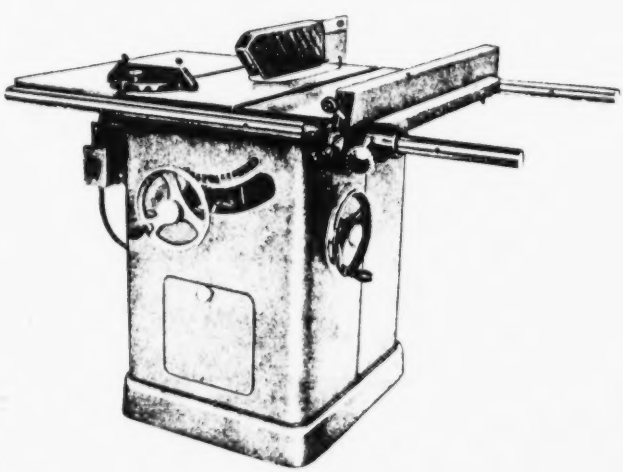

CHAPTER V

CIRCULAR SAW

A. Description

The circular saw is a power-driven rotary cutting tool with a toothed, circular blade. It has an arbor speed of approximately 3,450 r.p.m. with the running speed of the saw at approximately 9,000 f.p.m. The saw cuts on the principle of a continuous set of cutting wedges.

B. Safety

1. Personal
   a. Wearing goggles or face shield is a must precaution when saw is in operation.
   b. Loose clothing should be either tied down or removed.
   c. All students not involved in the sawing operation must stay out of the saw area.
2. Machine
   a. The blade should extend above stock not more than 1/4".
   b. All adjustments should be made when the saw blade is stopped.
   c. The saw guard is to be in place whenever possible.
   d. In ripping stock which is less than 6" in width, a push stick must be used.
   e. In ripping stock wider than 6", the little finger of the right hand should be hooked over the rip fence and slid

along its length.

f. If the fence is used as a stop in crosscutting duplicate parts, a spacer block clamped to the fence near the operator must be used.

g. In the crosscutting operation, both hands are placed on the miter gauge.

h. Disconnect electrical power when blades are changed or when a set-up close to the blade is made.

i. Always leave saw table clean and the blade below the table surface.

C. Adaptations

1. Setting Various Angles on the Miter Gauge and on Blade Tilt Control

a. If much angular work is done, it is worthwhile to adapt the miter gauge and blade-tilt dials for tactual reading. You can mark permanently with brass escutcheon pins or temporarily with dots raised in plastic tape.

b. For the standard angles (30^{o}, 45^{o}, and 60^{o}), drafting triangles serve very well in setting angles.

2. Setting Blade Height

a. The trial and error method can be used on a scrap of wood.

b. A gauge block with 1/8" graduations can be made for quick measuring.

3. Determining the Alignment of the Wood to the Blade

a. Two saw extension lines can be scribed on the table; one

for the inside of saw blade, the other for outside of blade.

b. If the miter gauge is used and added help is needed in holding stock in alignment, attach a piece of sand paper to the face of the miter gauge

4. Determining the State of Motion of the Blade

Use a small scrap of stock extended off the blade side of the miter gauge, and make a trial cut

D. Orientation

1. Safe Approach

a. Use the cross-body positioning of hands and approach the machine to make initial contact.

b. A safe initial point of contact would be the edge of the table closest to the operator in normal operating position.

2. Determine state of Motion of the Blade

a. First be sure switch is off.

b. Make a trial cut on a scrap piece of stock positioned in the miter gauge.

3. Machine Examination (with plug out)

a. Position yourself in front of table so that rip fence is to the right of you.

b. Make an examination of the top of the table (note: care must be taken so as not to jam fingers into the blade in the middle of the table)

c. Upon examination of table you will find two grooves that run lengthwise on either side of the blade. These are the

grooves that the miter gauge rides in.

d. The rip fence is usually set to the right of the blade and on top of the table. It is fastened to the machine on either end of the fence and slides along guides attached to the edge of the table. The rip fence is set to hold fast by a handle at the end of the fence closest to you. To release fence, handle is lifted. Some fences have a knob for fine adjustment. It is located to the right of the lock-down handle, and is usually spring-loaded so that in order to use, you must press in and then turn to the right or left for adjustments.

e. To regulate the height of the blade there is a hand wheel located under the table on the front side of the base of the saw. When you turn the wheel to make adjustments in the height of the blade, it is necessary to check the blade to see which way you are going and how high you have gone. Again the trial and error method is used in setting the blade height. Make sure that blade is stopped in between trials.

f. There is also a wheel that regulates the tilt of the blade. On most models the blade tilt wheel is on the left side of the base, although on others it is on the right side.

g. The miter gauge is used in cross-cutting operations. It is not attached to the saw, but merely slides in one of the two grooves provided on either side of the blade. The miter gauge can be set at different angles by loosening the knob

and setting the angle desired. See Section C, Adaptations, number 1, for adapting miter gauge to be readable for the visually handicapped.

h. The on-off switch is usually located under the table and to the right of the blade raising wheel. Some switches are on the left of the hand wheel. Regardless of where the switch is, it is important to be aware of it at all times so as not to bump it on, when making adjustments.

i. The guard is located directly over the blade. There are many types, but all are meant to protect the operator against accidentally touching the blade. The guard must be raised to make blade settings but it should be put back in place whenever cutting is being done. There are some types of cuts that necessitate the removal of the guard. When doing these cuts, caution must be taken to use proper placement of fingers so that you will reduce the risk of cutting with the guard off.

E. Exceptions

1. Tilt Wheel Placement

a. On most of the Clausing circular table saws, the tilt wheel is on the left side of the base, and not the right.

b. On many more inexpensive home shop table saws there is no tilt wheel at all. The whole top of the table is tilted to give blade angles. The hazards of this type of saw are greater because the wood has a tendency to slip down. It

is recommended that clamps be used to hold the wood securely to the miter gauge.

c. The on-off switch is located in many different places on many different models, and there is no way of explaining all of them. The rule to follow is to know where it is and to become familiar with it to the extent of becoming automatic in your actions of finding it.

F. Operation

1. Use Safe Approach to the Machine

   a. Cross-body technique should be used to make approach.

   b. Make initial contact, and then position yourself to the operating side of the machine.

2. Determining the State of the Blade

   a. Check to see that power is off.

   b. As added precaution, use a scrap of wood positioned in the miter gauge to check blade motion.

3. Setting the Blade for the Desired Height

   a. Locate the hand wheel that raises the blade and crank it up until it is approximately the height that is desired. Check the blade frequently while cranking.

   b. Use one of the many measuring devices available. (See Chapter III, Measuring Devices.) Set blade to the height. Rotate the blade by hand to obtain the highest part of the blade teeth.

   c. Run a piece of scrap wood through to check for correct

height. A safe way of making the cut is to position the wood in the miter gauge with the end extending across the blade. Place one hand on the miter gauge holding down the wood. With the other hand, turn the saw on and then return it to the miter gauge. Make the cut by pushing the miter gauge past the blade until the cutting sound ceases. Remove your hands from the miter gauge and turn saw off.

d. When saw has stopped, make any adjustments in height of the blade.

e. When you want to cut all the way through the wood, the blade should be set to clear the wood on the top by 1/8". This can be done by laying the wood to be cut on the table and sliding it up to the blade. Then turn the blade up until you can feel that it is above the top of the board.

4. Cutting to Width with the Ripfence

a. Loosen the ripfence by lifting the lever attached to the end of the fence closest to you. Slide the fence to the right, beyond the width of cut desired.

b. Measure the width for the ripping operation from the blade to the fence by holding the rule against the blade and then bring the ripfence up to the rule until it slightly bumps it.

c. Lock down the fence with lock-down lever. Remeasure to make sure of correct width. (Note that the fence will move when the lock-down lever is depressed. A minor adjustment is usually required to insure accuracy.)

Caution: When ripping wood that is less than 6" in width always use a push stick to push the wood past the blade. When you are ripping pieces wider than 6" get in the habit of hooking your small finger of right hand over the fence to assure yourself of a safe distance between your fingers and the blade.

5. Setting the Blade for Angle Cuts

   a. Whenever setting the blade for an angle cut you must first raise the blade to a height that will allow you to compare for the proper angle.

   b. Turn the angle wheel until the proper angle of the blade is reached. (See: Section C, Adaptations, number 1.)

G. Maintenance

1. Oil

   a. It is recommended that a silicone spray lubricant be used in the place of oil because oil is more apt to collect saw dust and cause sticking.

   b. The spiral gears that drive the blade tilt and the blade raise should be cleaned before lubrication.

   c. The guides for the ripfence can be lightly oiled, also the lock-down lever.

2. Clean-up

   a. Slide the ripfence all the way to the right and lock down; be sure not to go off table top with the fence.

b. Make sure that the blade is withdrawn all the way under top of table.

c. The table top can be cleaned with a brush.

d. Periodically, the sawdust that collects under the table should be emptied.

H. References

1. Teaching Woodworking to Visually Handicapped Persons. An Instructor's Guide. Department of Health, Education, and Welfare, Washington, D. C., and University of Illinois, Urbana, Illinois. 1963.

2. Hammond, Donnelly, Harrod, Rayner. Woodworking Technology (Second Edition). Bloomington, Illinois. McKnight and McKnight Publishing Company, 1961.

3. Feirer, John L. Industrial Arts Woodworking (Second Edition). Peoria, Illinois. Charles A. Bennett Co., Inc. 1965.

4. Anthony, G. H. Instructional Aids and Devices for Use in the Industrial Arts Department at the North Carolina School for the Blind. Raleigh, North Carolina. 1962.

5. Delta Craft Publication. Getting the Most Out of Your Circular Saw and Jointer. Pittsburgh, Pennsylvania. Rockwell Manufacturing Company. 1953.

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CHAPTER VI

DRILL PRESS

A. Description

The drill press provides the rotary power for driving drills, bits, plug cutters, and many auxiliary attachments such as mortise chisels, grinding wheels, and shaper cutters. The vertical power is applied through the feed wheel (wheel and axle) to a pinion gear which engages a rack on the quill. The speed of the drill press may vary from 300 to 7,000 r.p.m. Speed is controlled by shifting the drive belt on a set of cone pulleys which operates on the principle of the wheel and axle.

B. Safety

1. Personal

a. Wear goggles or face shield whenever machine is in operation.

b. All loose clothing or jewelry is to be removed or taken off prior to operation.

c. All long hair is to be tied back to minimize danger of getting caught in drill.

d. Be aware of cutting parts while in operation.

e. Don't engage in conversation with others while in operation.

f. Use a brush, not your hand, for clean up after work is finished.

2. Machine

a. Use only round-shank drills in three-jaw chucks.

b. Change belt speeds only while machine is stopped.

c. Use the correct speeds for all drilling operations.

d. Always use clamps or fixtures to hold work.

e. Protect table when not working over center hole.

f. When making table adjustments, hold table securely.

g. Check to see if chuck key is out of chuck before turning drill on.

C. Adaptation

1. The on-off switch can be adapted to work by means of a foot switch. It should be shielded to prevent accidental operation. This, by no means, rules out the necessity for instruction in the use of the conventional hand-operated switch. The students should be competent in both but they will probably prefer the foot switch.

2. Another adaptation that is an asset on the drill press is the foot operated feed control. This frees both hands for holding work.

3. Because of the danger of leaving the chuck key in the chuck and applying power, it is suggested that some means be set up to eliminate this problem. One way to do this is to use a standard junction box and receptacle, wired so that the "hot" line is broken by the receptacle. A standard two-pronged household plug is shorted with a jumper wire across the prongs and used

to complete the circuit in the receptacle The chuck key is attached to the two-pronged plug by a short piece of heavy cord, so that when the plug is out the power can not be applied

D. Orientation

1. Safe Approach

a. Determine by sound if machine is in operation

b. With one hand held low and across body and the other hand even with head palm out, approach machine for initial touch
The belt guard, which is about head high, is a safe place to start orientation

2. Machine Examination (with plug out)

a. Position yourself in front of machine

b. Find chuck by sliding hand down front of guard, and quill, to bottom of spindle
The chuck is what holds the bits. It is equipped with three jaws that are tightened onto the bit with the chuck key

c. The chuck key is located in various places on different machines: some are mounted on a chain attached to the column; others are taped to the power cord; and some are free to store where wished

d. Locate table by dropping hand down from chuck
The table has a hole in the middle to allow the bit to pass all the way through the work
Some tables are slotted so that jaws of a portable vise can be mounted to them

e. Locate column at back of table.

Notice that the column runs from the base on floor to top where motor mounts.

The table can be moved up and down the column by loosening the table clamp on the side of the column even with table.

f. Find depth stop located on side of spindle housing.

The depth stop is a threaded stock with two round nuts that are moved up and down the threads for depth control.

g. Find feed handle located on right side of spindle housing behind the depth stop.

The feed handle is turned to lower the chuck down into the work. It usually has a spring to return the chuck to original position.

h. The quill lock is located in the front part of the spindle housing.

The quill lock is tightened down on the spindle to hold the spindle in a fixed position.

i. On-off switch is usually located in the front part of the spindle housing above the quill lock and below the belt guard.

j. Some machines have the on-off switch mounted on the motor while others are mounted on the left side of spindle housing.

E. Exceptions

1. Changing Speeds

Some drill presses are equipped with a variable speed pulley. To change the speed one only has to turn the hand wheel on the front of the belt guard, while on others the belt has to be placed on the correct pulleys to change the spindle speed.

2. Size of Drill Press

The capacity of the drill press is determined by the distance from the center of the chuck to the column. This is expressed in a diameter and ranges from 11" to 17". The distance from the table to the chuck also ranges from 10" on the bench model to 44" on the floor model.

F. Operation

1. Use the safe approach to the machine.
2. Set the correct speed for the drilling to be done.
   a. If the machine is equipped with a variable speed control, turn machine on to set the speed.
   b. If the machine is belt driven, remove the belt guard and move the belt to select the correct speed.
   c. Install the bit in the chuck by opening the jaws by hand until the bit will slide in. Tighten using the chuck key (be sure to remove chuck key after using). Rotate chuck with one hand, and with the other hand check to see that the bit is centered and not bent.
   d. Move the table to a correct height by putting the work to be drilled on the table, and then loosen the table clamp with one hand, being sure to hold the table securely with

the other hand. Lock the table and remove the work. Run the spindle down with feed lever so the bit is close to the table, and check to see if the hole in the table is centered under the bit. If it is not, loosen the table clamp slightly and turn table to center it.

e. Feed the drill bit down so the tip is under the table and use the quill lock to lock in position. Now screw the two round nuts down on the depth lock until they come to rest at the bottom of the stop. Release the quill lock and return spindle to original position.

f. Mount the work on the table. To assure correct alignment of hole, sink a scratch awl in wood at spot to be drilled. Using this hole, fit the bit to the hole in the work. Hold work with one hand, and feed the spindle down so that the work rests on the table. Care must be taken so as not to pinch your fingers under work. Now that the work is properly aligned on the table, secure the work to the table using a C-clamp, Jorgenson clamp, or cam lock.

g. With your right hand on the feed handle, turn on the drill press with the other. Turn the feed handle and drill with slight pressure until the stop is reached. Return the feed handle to original position. Turn off machine.

h. Remove the work and drill bit.

i. Clean table off with brush.

G. Maintenance

Some drill presses require periodic greasing while others have sealed bearings. Whenever a drill press is to be idle for a period of time, all machined parts should be coated with a film of oil.

H. References

1. Teaching Woodworking to Visually Handicapped Persons. An Instructor's Guide. Department of Health, Education, and Welfare, Washington, D. C., and University of Illinois, Urbana, Illinois. 1963.

2. Woodworking Technology (Second Edition). Hammond, Donnelly, Harrod, Rayner. McKnight and McKnight Publishing Company, Bloomington, Illinois. 1961.

3. Industrial Arts Woodworking (Second Edition). John L. Feirer. Charles A. Bennett Co., Inc., Peoria, Illinois. 1965.

4. Getting the Most Out of Your Drill Press. Delta Power Tool Division, Rockwell Manufacturing Company, Pittsburgh, Pennsylvania. 1954.

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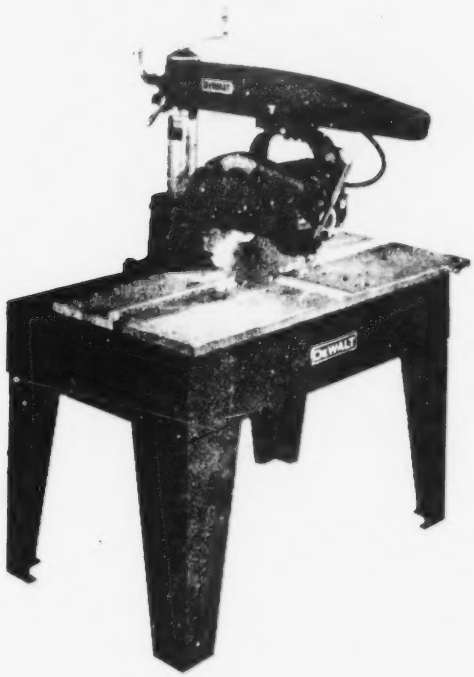

CHAPTER VII

RADIAL ARM SAW

A. Description

Circular cutters revolve at an arbor speed of between 3,450 and 3,600 r.p.m. The saw cuts on the principle of a continuous set of cutting wedges.

B. Safety

1. Personal
   a. Wear goggles or face shield whenever operating machine
   b. Loose clothing should be either tied down or removed.
   c. All students not involved in the sawing operation must stay out of the saw area.
2. Machine
   a. Guards should be in proper position and locked in place.
   b. All adjustments should be made before starting machine.
   c. Allow saw to obtain maximum speed before making cuts.
   d. Saw should not be allowed to cut too deeply into table.
   e. Saw should be equipped with an automatic return for the yoke-motor assembly.
   f. Never allow your hand to come behind the saw when cross-cutting.
   g. Return saw to original position after doing crosscutting operation.

C. Adaptations

1. If the motor-yoke assembly is not equipped with an automatic return, this should be one of the first adaptations that should be made. Without the return, the operator is not assured of the state of the blade, or where to find the handle on approaching the machine.
2. All the scales and dials on the machine can be marked for tactual reading. They are: the miter scale, arm swivel, yoke swivel, and blade bevel. It is not as important to mark all of the above if the saw has locks or stops at all the common angles.
3. To save time and avoid excess cutting of the table, a stop should be set up on the collar. This stop can be as simple as putting a C-clamp on the column at a point where it will not allow the saw blade to cut deeper than just under the level of the table top.
4. If at all possible, it is a good idea to set up a brake on the saw assembly. A brake reduces the hazards from the blade freewheeling after the saw is shut off, and the noise and vibration are at a minimum.

D. Orientation

1. Safe Approach
   a. Use the cross-body positioning of hands and approach the machine to make the initial contact.
   b. The initial contact with the machine can be made at the

edge of the table. Note because of the uncertainty of the position of the saw blade, immediate examination of the arm should be carried out, in order to find out if the motor-yoke assembly is returned to the original operating position behind the back guard strip.

2. Machine Examination (plug out)

Position yourself in front of the table and with one hand in front of you, cautiously lean forward to find the over arm of the saw. With your right hand on the radial saw, thumb over the top and fingers curled under the arm, slide your hand along the arm until you bump into the yoke assembly with your fingers. The yoke is attached on the bottom side of the radial arm, and it slides in tracks attached under the arm. The yoke holds the motor and blade assembly. The motor is equipped with a handle, that enables you to draw the saw towards you along the slides.

Directly below the radial arm is the table. The table has an insert which is used for ripping, crosscutting, and sawing. Another name for this insert in the table could be the fence, or the back guide strip. The fence is set 90^{o} from the radial arm, so that if a board is pushed against it, the cut will be 90^{o} or a right angle.

The column is a hollow steel tube that supports the radial arm. The column is attached at the base and has an elevating crank at the top, which allows the operator to raise or lower the arm. This is what is used to adjust the blade to the correct height.

E. Exceptions

1. Elevating Crank Placement

On some models like DeWalt and Delta, the elevating crank raises the whole column with the radial arm attached to the top of the column. On these and other models the elevating crank is located on the front part of the base, and just under the table.

2. On-off Switch Placement

The power switch varies in placement and it would be useless to say that it is found in any one place. There are a number of places to look, they are: on the end of the radial arm closest to operator; on top of the radial arm, both closest to operator and a foot or so back from operator; on the motor, sometimes within easy reach of your thumb when holding the handle of the saw and sometimes on the case of the motor itself; on the front part of the base, and just under the table; on a switch box located to the right of the column and mounted to the back edge of the table.

3. Location of Arm Clamp

The radial arm clamp can be located either on the back part of the column or at the end of the radial arm closest to the operator.

4. Location of Motor-yoke Swivel Clamp

There are two motor-yoke swivel clamps. One rotates the motor on the same axis for switching from crosscutting to ripping position. The other rotates the axis down, either part way for bevel cutting or all the way for routing. Because of the

varying placement of the lock-down clamps for the motor-swivel, it is advised that the swivel points should be found by investigating the yoke itself to determine the way the motor will swivel. The lever or clamp will be located on, or close to, the swivel point itself.

F. Operation

1. Use a Safe Approach to the Machine
   a. Cross-body hand technique should be used to make the initial contact with the edge of the table.
   b. Centered in front of the table, lean slightly forward to find the radial arm.
2. Determining the State of the Blade
   a. Listen to hear the motor or blade noise.
   b. Feel the radial arm for any vibrations.
   c. Check that power is off.
   d. If the shaft in the motor is exposed on the opposite end from the blade, place a finger on this to see if it is turning. Note: It is suggested that students memorize the route the right hand will follow from the handle to the right end of the motor shaft. This will enable the student to know exactly when the blade is stopped after operation.
3. Alignment of the Blade

   If the place to be sawed is laid out with a scratch awl, then you can pull the saw out to where the blade touches with wood and slide the wood along the fence until the blade catches in

the scratch mark. Note the saw kerf (groove where wood is removed by the saw blade) must be taken into consideration when aligning the work to the blade. For example, is the mark directly where the cut should be, or should the cut be to the right or the left of the mark. There can be as much as 1/4" difference in the length of the work, if the saw kerf is not planned for properly.

4. Crosscutting (90^{0})

The saw is used in crosscutting by placing the work to be cut on the table against the guide strip and then the cutting is done by drawing the saw towards you and through the work.

5. Ripping

a. The radial arm must be at right angles to the guide strip. This means the miter scale will register "zero."

b. The column should be raised until the blade clears the table.

c. Draw the saw to the front of the radial arm and lock.

d. Rotate the motor-yoke 90^{0} so that the saw blade is parallel with the guide strip. Lock in position.

e. Release the yoke lock and move the saw to the desired width of cut. Remember that all the measuring is done from the front side of the guide strip to the inside of the saw blade.

f. Lower the saw so that it cuts slightly into the table.

g. Set the safety guard so that it clears the surface of the stock.

h. Lower the kick-back fingers so they rest lightly on the surface of the stock. (Not all saws have the kick-back

device.)

i. Place the work on the table and against the guide strip. Turn the saw on and push the work along the guide strip. Use a push-stick if the piece is narrow, or when you come to the end of the cut. Never allow your hand to go beyond the blade.

6. Cutting Miters

a. Raise the column so the blade clears the table.

b. Release the arm clamp and swing the arm to the desired angle.

c. Lock the arm and lower the column to just below the surface.

d. Pull the saw out towards you to check if there is a slot through the guide strip. If there is not, one must be cut before you do the actual cutting on the work.

e. Extra care must be taken as to how you should hold the work down. If you can not hold it with your hand safely, then you should use a clamp to hold the work to the guide strip.

G. Maintenance

1. The track that the yoke travels in should be cleaned and lightly oiled periodically as it is used.
2. The column can be raised all the way and should be cleaned and lightly oiled.
3. The crank can be cleaned and oiled at the bearing point.
4. The blades should be checked for sharpness before using the saw. A good test for sharpness is to make a cut on a wide board and notice the ease of cutting. If the saw burns the wood and slows

down when making the cut, the blade might be the reason and should be replaced with a sharp one.

5. If the table top and the fence or guide strip get cut up too badly to be able to line wood up and make a safe cut, then the table can be unscrewed and replaced.

H. References

1. Teaching Woodworking to Visually Handicapped Persons. An Instructor's Guide. Department of Health, Education, and Welfare, Washington, D. C., and University of Illinois, Urbana, Illinois. 1963.

2. Hammond, Donnelly, Harrod, Rayner. Woodworking Technology (Second Edition). Bloomington, Illinois. McKnight and McKnight Publishing Company. 1961.

3. Feirer, John L. Industrial Arts Woodworking (Second Edition). Peoria, Illinois. Charles A. Bennett Co., Inc. 1965.

CHAPTER VIII

WOOD LATHE

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CHAPTER VIII

WOOD LATHE

A. Description

A lathe is a machine on which a face plate or a spur center is attached to a motor driven spindle which revolves at an adjustable speed. The work is mounted on the face plate or between centers and is shaped by turning against chisels or special cutters which cut on the principle of a cutting wedge. The speed of the lathe may be regulated between 300 and 3,600 r.p.m.

B. Safety

1. Personal
   a. A face shield is always worn by a lathe operator when he is turning wood.
   b. Loose clothing should be either tied down or removed.
   c. All students not involved in the turning must be outside the wood turning area.
2. Machine
   a. The tool rest must be kept close to the stock, preferably 1/4 of an inch.
   b. The proper speed must be set and checked carefully before any power is applied to the lathe.
   c. Stock being turned must be revolved one revolution by hand after being set up or following adjustment in the tool rest

in order to be sure that it will turn freely.

d. Progress checking with the hand is done only after the machine has been brought to a complete stop.

e. The tool rest must be removed during sanding operations.

f. The operator must be sure that the wood he is planning to use contains no slits, chips, or poorly glued joints.

C. Adaptations

1. A shielded foot switch is a valuable adaptation. Since the lathe must frequently be started and stopped in checking the progress of the work, a foot switch will free one hand to slow down the lathe and to help line up the cutting tool for the start of the next cut.

2. Tactual marks on the bottom side of the tools aid the operator in judging the location of the cutting edge. The simplest method of marking is to place a single layer of tape, such as plastic electrical tape, across the chisels so that it will be close to the tool rest when the chisel is in position for cutting.

D. Orientation

1. Principal Parts

The lathe is comprised of a head stock, live center, tail stock, tail stock clamp, tail stock hand wheel, the lathe bed, tool rest holder, tool rest, motor, belt, and driving pulleys. The head stock, which contains the driving mechanisms, is cast iron

with two sealed bearings. If the lathe is a direct drive, the motor is part of the head stock. If the lathe is belt driven, the pulleys are located in the head stock. The driving mechanism's spindle is hollow and extends beyond the head stock at both ends. The inboard end has a right hand thread for attaching a face plate while the outboard end has a left hand thread for attaching a face plate for outside turning of larger diameters than the swing of the lathe will accommodate. The live or spur center, made of an unhardened tool steel, has a tapered shank to fit the spindle and supports the stock on the left end when turning between centers. It is called the live center because it turns with the head stock. A cast iron tail stock holds the dead center which serves as a pivot. The tail stock is equipped with a hand wheel which, if turned clockwise, will extend the dead center. The dead center is made of hardened tool steel and supports the stock on the right side when turning between centers. There are two types: cup and cone centers. They have a tapered shank to fit the tail stock spindle. The tool rest, made of machine cast iron, provides support for the lathe tools. The cast iron bed supports the head stock, tail stock, and tool rest holder. The tail stock clamp secures the tail stock to the bed. The tool rest holders secure the tool post to the bed and the tool rest clamp makes the tool rest secure at the desired height.

2. Safe Approach

Use the cross-body positioning of the hands and approach the

lathe to make the initial contact somewhere along the lathe bed.

3. Machine Examination

   a. Position yourself in front of the lathe so that the head stock is to your left and the tail stock to your right.

   b. Place your left hand on the lathe bed, and run it left until you touch the head stock. Investigate the head stock. Note that the spindle runs through the head stock with a threaded portion on either side of the head stock. The spindle is hollow, and on the inboard side has a taper to house the live or spur center. If the lathe is driven by a belt and pulley then the top of the head stock can be removed by loosening the thumb screw. This allows you to change the spindle speed by changing the position of the belt on the pulley.

   c. If you run your hand right along the lathe bed, you will next come across the tool rest holder. The tool rest holder has a clamp which clamps onto the tool rest.

   d. Continuing to slide your hand to the right, you will next come onto the tail stock. The tail stock houses the dead center. The tail stock also has a spindle which is tapered on the inside to house the dead center. This spindle can be extended by a tail stock hand wheel which is located on the opposite side of the tail stock.

   e. The location of the on-off switch varies with different machines. Most lathes have a switch under the lathe bed. It is a decided advantage to adapt a machine with foot operated

switch. This allows your hands the freedom of placing the tool before the switch is thrown.

E. Exceptions

1. Changing Lathe Speeds

a. The speed of a belt driven lathe is changed by changing the position of the belt on the cone pulleys - when the driving pulley is smaller than the driven pulley, the speed is reduced, when the driven pulley is smaller than the driving pulley, the speed is increased.

b. Some models regulate the speed by means of a variable speed motor. On these models there is usually a hand wheel which if turned one way increases the speed, and if turned the other way decreases it.

c. On some belt driven lathes the speed is adjusted by a hand wheel. These lathes are equipped with a variable speed pulley.

2. On-Off Switches

As mentioned in section D, 3-e, the location of the on-off switch varies with different models. Two popular places for the on-off switch to be mounted are: on the face of the head stock, and just under the bed in front.

F. Operation

1. Use Safe Approach to the Machine

a. Cross-body techniques should be used to make approach

b Make initial contact, and then position yourself to the operating side of the machine

c Check to see if power is off

2. Mounting Wood for Spindle Turning

a Select a piece of wood that is overall at least one inch longer than the piece needed for the turning. Make sure the wood is close to square.

b Stand wood on one end on table and with a scratch awl and straightedge, scribe a line between corners on end. This will accurately place the center of the wood. To further mark the centers, sink a scratch awl at this intersection and work it around in a circle to make a well-defined hole at both ends.

c Turn the wood over and repeat the procedure as in "b"

d Lock work in vise, with one end standing up straight. With a back saw or dovetailed saw, saw on the scratched marks previously scribed in the wood. The saw kerf should be about 1/8 of an inch deep.

e With the wood still locked in the vise, position the spur center in the previously sawed grooves. Tap the end of the spur center in the grooves. Note: If the spur center is mounted in the head stock, it will be necessary to drive it out using a rod through the open end of the spindle opposite the spur center.

f With the spur center still mounted on the work, slide it into the spindle. Support the right end of the work with

your left hand, and with your right hand loosen the tail stock assembly and slide it up to the end of the work. Lock the tail stock assembly in position. Loosen the tail stock spindle clamp, and turn the hand wheel so that the dead center is pushed into the exact center of your work. Tighten tail stock spindle clamp.

g. Rotate the work by hand. Check how close to center the work is mounted.

h. Loosen tool rest holder clamp and position tool rest holder in center of your work.

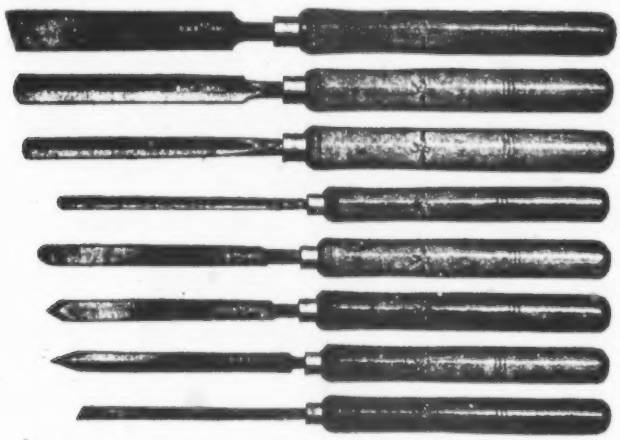
i. Loosen the tool rest clamp and raise the tool rest so that the top edge is slightly above the center of your work. Check to see that the tool rest is parallel to the closest edge of your work, and that the space in between is no more than a quarter of an inch. Rotate the work again by hand to check that your work is free to turn.

3. Holding the Lathe Tool

It is important to hold the tools so as to get optimum leverage out of them. If you are right-handed, clasp the wooden handle of the tool with your right hand. Rest the metal part of the tool on the tool rest and grasp the metal part between your thumb and index finger of your left hand. Slide your left hand until your index finger touches the tool rest. The index finger of your left hand acts as a guide in controlling the depth and contour of the cut. You should practice keeping the tool perpendicular to the tool rest while moving the full length of

the tool rest.

4. Types of Lathe Tools and Uses



There are two types of lathe tools, scraping-action tools and shearing-action tools. The operation of scraping-action tools should be mastered before the operator attempts shearing-action tools. For several reasons this is true: psychological, health, and economical (spoiling of materials). Scraping tools such as round-nosed, square-nosed, and diamond point chisels, can do anything that can be done by shearing-action tools such as gouges and skews. A scraping cut usually requires some additional sanding, but it is felt that this is a minor point in the learning experience of a wood turner. Skews and other tools used in shearing cuts are difficult for both blind and sighted learners to master; they also involve tools which must be used constantly to be maintained. Therefore, unless the student wishes to do considerable wood cutting, he is not advised to learn the use of shearing-action tools.(1)

(1) Teaching Woodworking to Visually Handicapped Persons, page 67.

a. The round-nose is a flat scraping chisel used in roughing and shaping concave surfaces. The end is rounded and has a single bevel of about 30 degrees. The common sizes of round-nosed chisels are 1/8 inch, 1/4 inch, 1/2 inch, and 1 inch.

b. The square-nose is a flat scraping chisel used to make flat, straight cuts. It resembles a standard wood chisel in shape but has a thicker and longer blade. The end is square and has a single bevel of about 30 degrees. The most common sizes of square-nosed chisels are 1/2 inch and 3/4 inch.

c. The diamond point is a flat scraping chisel used to make V-cuts or beads. The pointed cutting edges are formed by grinding the sides to desired angle at a bevel of 30 degrees. The most common size of the diamond point is 1/2 inch.

d. The parting tool is a scraping chisel used to make narrow, deep cut and depth cuts for sizing when shaping for profiles. The thickness of the blade is greater at the center than at the edges. The blade is ground at an angle from each edge to the center, thus forming a flat, pointed turning edge, which reduces binding and friction for heating when cutting. The common sizes of cutting tools are 1/8 inch and 3/16 inch.

e. The gouge is a turning chisel used in roughing out cylinders and in turning concave surfaces on spindles. Its blade is concave-convex in a cross section, with a rounded bevel cutting edge. The cutting edge is rounded to prevent the

tool from digging into the work being turned. The bevel is approximately 30 degrees which aids in making scraping or shearing cuts. The common sizes of gouges are 3/8 inch, 1/2 inch, 3/4 inch, and 1 inch.

f. The skew chisel is a flat turning chisel used in smoothing cylinders, rounding edges, and in making shoulder and V-cuts. It can be used with either a shearing or a scraping action. The end of the skew forms a 60 degree to 70 degree profile which is bevelled at both sides to form a cutting edge of approximately 40 degrees. The common sizes of a skew chisel are 1/4 inch, 1/2 inch, and 1 inch.

5. Starting to Cut

a. With the wood mounted in between centers, set the tool to the proper height. This is slightly above center of the work.

b. Assume a natural position with the feet slightly spread and one foot a little behind the other, and with the weight evenly distributed.

c. Select the large gouge. Grasp the handle well out towards the end with the right hand. With the left hand, hold the blade and guide it along the tool rest. Work from the center toward the end. It is advisable to get the feel of this position before starting the lathe.

d. Set the lathe on the slow speed, approximately 600 r.p.m.

e. For working the rough stock down to round, a scraping action should be used. The gouge is held in a horizontal

position, using the tip end of the tool to do the cutting. This will produce a rough cut. To avoid long splinters, a series of cuts may be made with the narrow gouge by placing it approximately 45 degrees on the rest with the tip over the work.

f. Before starting the lathe, position tool on tool rest and back away from the work about 1/4 inch. Turn the lathe on with your left hand, and return it to the tool. Make sure, when you return to the tool, that you first grasp the tool by the handle and then slide your hand in until your index finger bumps the tool rest.

g. Continue to turn until the piece is cylindrical. It is necessary to move the tool rest in closer to the work as the piece is worked down. This reduces the chance of a tool catching in between work and the tool rest. Caution: Whenever checking the work, always turn off the lathe. Make sure it has completely stopped by lightly feeling the outboard side of the spindle.

6. Layout

a. All linear dimensions are laid out on the stock with a rule and a parting tool or a diamond point tool.

b. The diameters at these points are turned (allowing some stock for sanding) with the aid of an outside caliper.

c. Next turn the contours between their completed diameters.

G. Maintenance

1. The spurs and points of live centers should be kept sharp.

2. The working edge of the tool rest should be kept smooth. Recondition by draw filing.

3. The original shape of the cup center should be maintained. A cone center should be ground only by an experienced person.

4. Bearings should be kept lubricated.

5. The tail stock may vibrate out of line and will need adjusting.

6. Belts may need adjusting or replacing.

7. Wood dust should be blown from the motor periodically.

H. References

1. Teaching Woodworking to Visually Handicapped Persons. An Instructor's Guide. Department of Health, Education, and Welfare, Washington, D. C., and University of Illinois, Urbana, Illinois. 1963.

2. Woodworking Technology. Hammond, Donnelly, Rayner, (Second Edition). McKnight and McKnight Publishing Company, Bloomington, Illinois. 1961.

3. Industrial Arts Woodworking. John L. Feirer, (Second Edition). Charles A. Bennett Co., Inc., Peoria, Illinois. 1965.

CHAPTER IX

SANDERS

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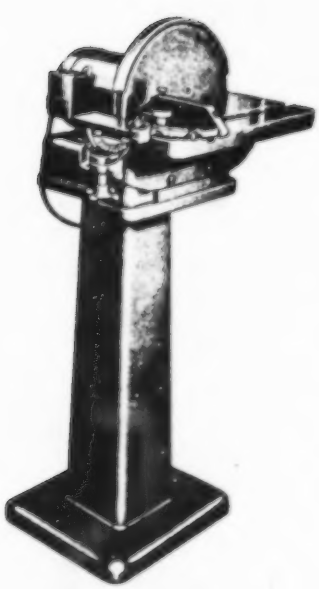

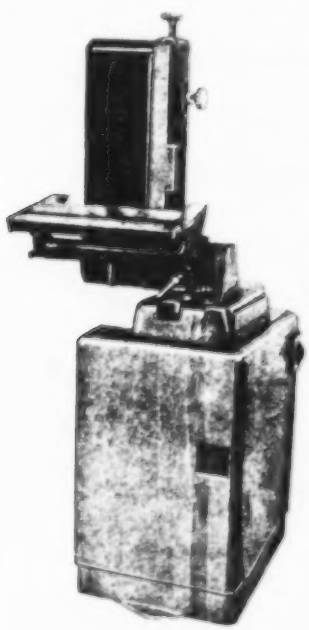

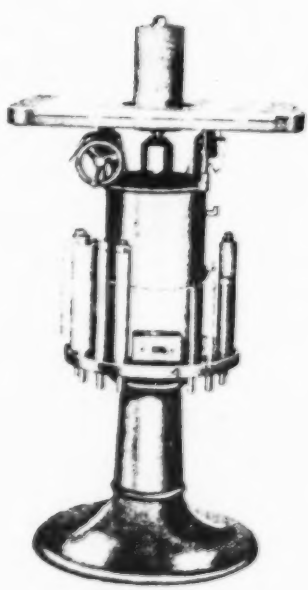

CHAPTER IX

SANDERS

A. Description

1. A spindle sander has a rubber-coated spindle to which is fitted the coated abrasive sleeve. A spindle simultaneously rotates and oscillates up and down. Spindle sanders are used to sand concave curves on edge. Sleeve diameters range from 3/4 inch to 3 inches and lengths from 6 inches to 9 inches.
2. On the belt sander, a cloth-coated abrasive belt revolves on one driver and one idler pulley while passing over a flat table on which stock is placed for sandings. Belt sanders are used to sand flat surfaces. Belt widths range from 4 inches to 8 inches and lengths from 4 feet to 26 feet.
3. On the disc sander, a coated abrasive disc is attached to a metal disc which will revolve in a clockwise direction. Disc sanders are used to sand straight and convex curves on edge. Diameters of the discs range from 8-1/2 inch to 18 inch.

B. Safety

1. Personal
   a. Safety glasses or a safety shield should be worn when operating a sander.
   b. Loose clothing should be either tied down or removed.
   c. All students not involved in the operation of sanding must

stay out of the sanding area.

2. Machine

   a. Belts should be properly tracked in order to keep the belt on the rolls.

   b. In using the disc sander, sand on the downward rotation.

   c. Do not use torn belts.

   d. Care should be exercised in sanding splintered stock.

   e. The table of the disc sander should be set to just clear the disc. This eliminates the possibility of catching wood in between the disc and the table.

   f. If much wood is to be removed, this should be done by hand or with a different machine prior to the sanding operation.

   g. Sanding on small objects that would bring the fingers dangerously close to the disc or the belt should not be attempted.

C. Adaptations

1. When sanding the entire edge of the board on a belt sander, a board can be set up 90 degrees and perpendicular to the belt table, to act as a guide for a true edge. The before mentioned jig is not needed if the sander is equipped with a table.
2. Some less expensive sanders have the belt exposed and both of the wheels unguarded. This type of sander is hazardous enough for the sighted but is even more dangerous to the visually handicapped because there is no safe point of primary contact. If such a sander is encountered, the first adaption should be safety guards around both wheels and bottom of the belt.

3. A circle cutting jig, usually adapted to the band saw, can be used to true the edge of flat discs on the disc sander. The jig rides in the miter grooves on the table of disc sander.
4. The table tilt on the spindle sander is usually calibrated in degrees. This tilt scale can be adapted for tactual reading if much angular work is done on the spindle sander.

D. Orientation

1. Belt Sander

   a. The primary point of contact on the belt sander should be the metal housing enclosing the belt.

   b. The important controls to be located along the same paths of travel from the point of contact on the belt sander, include the on-off switch, the tracking adjustments, and the table or fence adjustments.

   c. The belt on the belt sanders can be mounted vertically or horizontally. If it is mounted horizontally there is usually not a table provided. If it is mounted vertically, the primary point of contact is the edge of the table.

2. Disc Sander

   a. The primary point of contact with the disc sander should be the front edge of the table.

   b. The important controls to be located on the disc sander are the on-off switch, the tilt adjustment for the table, and the slot for the miter gauge.

   c. The disc sander is sometimes equipped with a brake. Because

the disc of a disc sander is usually a large casting it acts as a fly wheel, which allows the discs to coast for an extended period of time after the power is shut off. The brake should be pulled to stop this motion before the machine is left.

d. The safest procedure in approaching the machine is to make the primary point of contact at the edge of the table, and then use a piece of scrap stock to press against the sanding disc to determine the state of motion of the machine.

3. Spindle Sander

a. The primary point of contact on the spindle sander can be anywhere on the perimeter of the edge of the table.

b. The important controls for the spindle sander are the on-off switch and a tilting mechanism on the table.

E. Exceptions

1. As mentioned before, some belt sanders are not equipped with a guard over the bottom portion of the belt and the two driving wheels.

2. There are some models of belt sanders that can be operated either on a vertical or horizontal plane. On these models, particular attention must be paid in aligning the belt after the position of the belt is changed.

3. Some machines are a combination disc and belt sander. On these machines, special attention must be taken for safety, because while one is being used, the other is free-wheeling.

F. Operation

1. Belt Sander

   a. The cross-body hand technique should be used in making the initial approach to the machine.

   b. Make the initial contact on the metal housing.

   c. Use a piece of wood held lightly in the hand to ascertain the state of motion of the machine.

   d. Check the power switch as an added precaution.

   e. If you are going to do an edge sanding, stand the wood on edge on the top of the belt. Check to see that the wood is perpendicular to the surface of the belt.

   f. Lift the stock slightly so that it just clears the belt.

   g. Hold the stock with one hand and turn the switch on with the other.

   h. Lower the stock lightly and sand each edge. Caution: Do not force the stock down onto the belt, but let the belt do the cutting.

   i. If you are doing a face sanding, use a push stick to support the trailing edge of the board. Hold the board on the front edge with your fingers positioned lightly on the top.

2. Disc Sander

   a. Use the cross-body positioning of the hands to make the initial approach to the machine.

   b. Make the primary point of contact on the front edge of the table.

   c. It is extremely important that you ascertain the state of

motion on the disc sander. To do so, position a piece of wood on the table and slide it forward until it touches the disc

d. Remember that all sanding is done to the right side of the center of the disc.

e. Position the stock on the table in front of the disc.

f. Apply the power and sand.

3. Spindle Sander

a. Use the cross-body positioning of the hands to make the initial approach to the machine.

b. The primary point of contact is the edge of the spindle sander table.

c. Determine the state of motion of the sander.

d. Position the work on the table next to the spindle.

e. Turn the power on and sand.

G. Maintenance

1. Oil

a. All moving parts should be kept oiled unless equipped with a sealed bearing

b. Whenever sanders are left unused for a long period of time, machined parts should be coated with a thin film of oil to prevent rusting.

c. If the belt sander is equipped with an oil reserve the level must be maintained.

2. Change all worn or torn sanding papers and belts

a. The abrasive sleeve on the spindle sander can be changed by holding the spindle fast and loosening the nut on the top of the spindle. Note: Care must be taken in tightening the nut after replacing an abrasive sleeve. If excess pressure is applied on the nut it may split the abrasive sleeve.

b. The disc on the disc sander is glued on after removing all traces of the old sanding disc.

c. The metal housing and guards must be removed from the belt sander before the belt can be removed. Again, caution must be taken in adjusting the tension of the new belt.

H. References

1. Teaching Woodworking to Visually Handicapped Persons. An Instructor's Guide. Department of Health, Education, and Welfare, Washington, D. C., and University of Illinois, Urbana, Illinois. 1963.

2. Woodworking Technology (Second Edition). Hammond, Donnelly, Harrod, Rayner. Bloomington, Illinois. McKnight and McKnight Publishing Company. 1961.

CHAPTER X

BAND SAW AND SCROLL SAW

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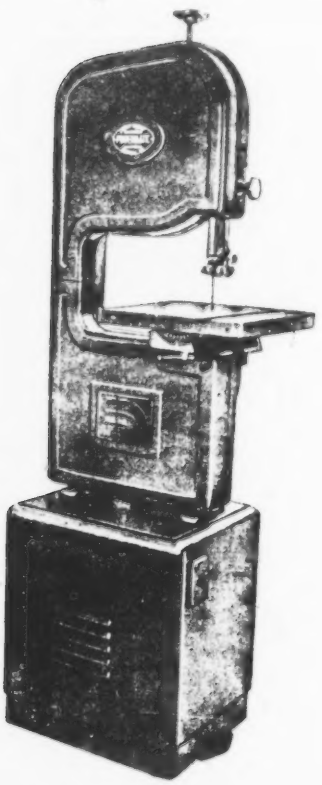
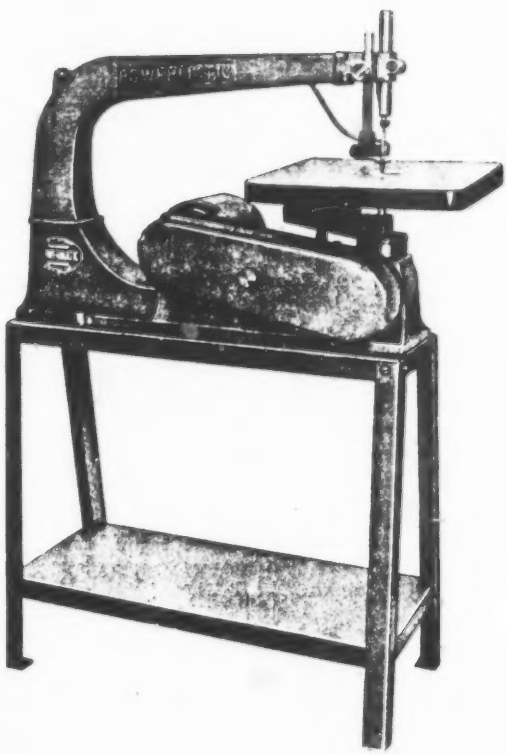




CHAPTER X

BAND SAW AND SCROLL SAW

A. Description

1. The band saw is used to cut curves and for resawing. It works on the principle of an endless, flexible steel belt with . b teeth filed on one edge moving at a speed ranging from 3,000 to 5,000 feet per minute.
2. The scroll saw or jig saw is also used to cut curves. The steel blade, with rib teeth formed on one edge, reciprocates at a speed of from 600 to 1,750 strokes per minute.

B. Safety

1. Personal
   a. Wear goggles or face shield whenever operating machine.
   b. Loose clothing should be either tied down or removed.
   c. All observers or students not involved in the sawing operation must stay out of the saw area.
2. Machine
   a. Use the machine only when all guards are in place.
   b. Adjust upper guide for clearance. Too high a setting leaves the saw unguarded.
   c. Keep the hands away from a moving blade.
   d. Small chips which lodge in the guide blocks jam the blade. Stop the saw and remove them.

f. After a new blade is mounted and before power is applied, the machine should be revolved by hand to test its free movement.

g. The radii of all curves to be cut must be large enough for the blade being used. Never force the blade to cut too sharp a curve. Curves that are too small result in strain on the blade and a danger of the blade being broken.

h. Cylindrical stock, when being cut to length, must be held in a V-block or a clamp to prevent its turning.

i. On the band saw, the operator must be constantly alert for a clicking noise indicating that there is a danger of the blade breaking.

j. In the event of a broken blade, the student should step away from the machine, pull the power plug, and wait for the wheels to come to a halt.

C. Adaptation

1. Band Saw

a. A circle cutter is a good modification for cutting circles on a band saw.

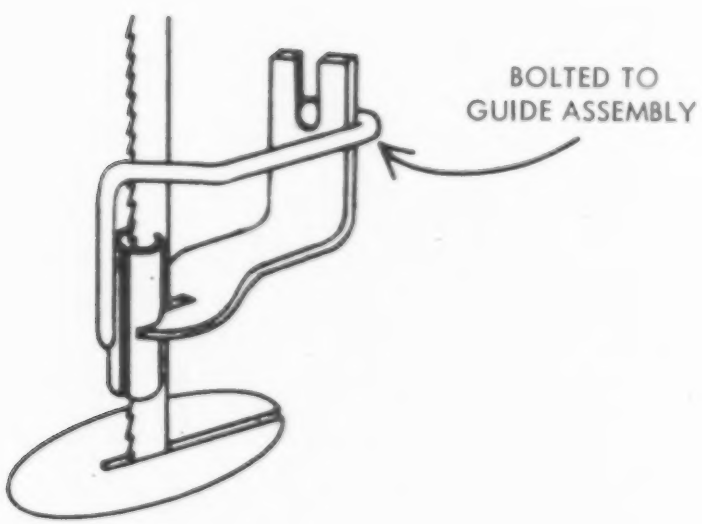
> a circle cutter is made of nova plywood, is a 12"x16", with a 1-3/4" groove cut to permit a 3/8" x1-3/4" slide with pivot pin to be used for setting varied centers of circles or corners. The pivot pin is located 1" from the blade end of the slide. (1)

b. For following lines scribed in stock, a metal pointer can

1. Instructional Aids and Devices for Use in the Industrial Arts Department at the North Carolina School for the Blind, p. 28.

be mounted, with point down, on the upper guide of the saw. The pointer should be positioned just in front of the saw blade. The pointer actually serves two functions: when properly designed for a particular use and saw, it follows the grooved line if the upper guide is positioned at the right height; second, it serves as an added saw guard.

c. If the band saw is not equipped with a foot brake for the blade, it should be looked into as a possible addition to the machine. This would eliminate the long wait after the power is shut off before the blade stops. The band saw should never be left with the blade coasting.



Jigsaw Guide

2. Jig Saw

a. Free hand curves can best be handled with the aid of a pointer guard similar to the one described for the band saw. The pointer guard can be bolted to the pressure foot guide assembly on the jig saw.

b. Additional guard can be made from a 1/4" diameter sleeve, and mounted to the pressure foot. This can be done by drilling the hold down pressure foot to receive the 1/4" sleeve and then brazed in position. Once the sleeve has been mounted to the pressure foot, a slot can be cut in the front and rear of the sleeve in order to allow passage of the saw blade. With the combination of the sleeve and pointer guard the teeth of the blade are shielded, which reduces the possibility of injury.

D. Orientation

1. The Band Saw

a. The saw should be approached by using the cross-body positioning of the hands, with the primary point of contact at the edge of the table closest to the operator when he is in normal operating position.

b. It is most important to determine the state of motion of the band saw blade. The blade will coast a considerable length of time after the power has been shut off, due to the heavy cast wheels that drive the blade. The motion of the blade can be determined by first checking the power

switch and second, attempting to cut a piece of scrap stock of adequate size to be safe

c. Electrical power should be disconnected while investigation of the machine is taking place. The various adjustable controls to be located are the fence, the miter gauge and groove in the table, the height adjustment locking handle for the upper guide.

2. Jig Saw

a. The saw should be approached with the cross-body positioning of the hands with the initial contact made at the edge of the table.

b. Because of the distinctive noise of the jig saw, the state of rest should be obvious on approach.

c. Important controls to be located are the on-off switch, the pressure foot adjusting lever

d. The only other important control is the blade tension sleeve. The blade is usually mounted by a set screw on the top and bottom. The blade tension sleeve should be set after the blade is mounted.

E. Exceptions

1. Band Saw

a. On-Off Switch

The power switch is usually located on the frame or yoke at about the height of the table On some models, the power switch is located on the base just under the level of the

table.

b. Size of Saws

The size of the band saw is dictated by the diameter of the wheel. Wheels are available in sizes 12", 14", 16", 18", 24", 30", 36", and 40". Large size machines are not usually found in school shops.

2. Jig Saw

a. Kinds of Driving Mechanisms

The plunger type jig saw is the most common in school shops. It works on the principle of the wheel and axle. The belt-driven pulley is connected to a cam and pitman mechanism. As the cam rotates, the pitman pushes and pulls the lower chuck up and down. The upper end of the blade may be held in a chuck which is attached to the plunger and spring tension control.

The magneto type jig saw is operated by a circuit breaker. In the power stroke, an electromagnet pulls down the lower chuck, which holds one end of the blade. When the chuck reaches the lower limit of its stroke, the circuit is broken and a spring in the tension sleeve returns the blade to its upper limit. The cycle is repeated.

The rocker arm type works on the principle of a wheel and axle. The belt-driven pulley is connected to the cam which drives a rocker arm to produce the up and down motion.

b. Blades

A saber blade can be mounted in the lower chuck in place of

a scroll saw blade which is usually mounted top and bottom. When using the saber blade the upper chuck and guide can be removed to give unlimited space for the work.

The jeweler's blade, which is held in the upper and lower chucks, is used for fine work.

Jig saw blades have rip teeth and vary in length, thickness, and number of teeth per inch. The finer the cut to be made the more teeth per inch, and the finer the thickness of the blade. Blades vary from seven teeth per inch for soft woods to thirty-two teeth per inch for cutting metals and other hard materials. Blades with about fifteen teeth per inch may be used for all purposes.

F. Operation

1. Band Saw

   a. Use the proper approach and initial point of contact.

   b. Determine the state of motion of the blade.

   c. Make sure that all outlines to be cut are clearly scratched with a scratch awl.

   d. Adjust the saw guide to give about 1/4" clearance above the thickness of the stock. If a shop-made metal pointer is mounted to the upper guide of the saw, then position the pointer so that it rides in the groove scratched.

   e. Position the wood on the table so that the scribed line is lined up with the metal pointer.

   f. With one hand holding the wood in position, turn on the

power and apply even, forward pressure with the right hand.

g. To cut a sharper curve than the width of the blade will permit, make relief cuts in the waste stock. Relief cuts should not touch the line. Backing the blade out of the cut is not recommended. The work should be planned so that on each cut you can saw out.

h. For resawing, fasten the rip fence or wooden guide securely to the table. The distance from the fence to the blade should be the desired thickness of the resawed piece.

i. When cutting more than one piece fastened together, the nail holes should not appear in the finished piece. If possible, place the nail in the scrap piece so that when the saw cut is finished, it will clear the work.

j. Band saws cut rapidly, but should not be forced so that the edges of the cut are burned.

2. Jig Saw

a. Use the safe approach to make the initial contact.

b. Lay the stock on the table and adjust the pressure foot to hold the wood down.

c. Line the scratched mark up with the pointer or guide in front of the saw blade.

d. Turn the drive shaft one revolution by hand to check that all adjustments are right.

e. Start machine and feed the work forward evenly. Apply downward pressure to prevent the work from jumping with the saw blades. Always examine stock before cutting to make

certain it is free from nails, grit, and other foreign materials.

f. When cutting inside work, you should drill small holes in the waste stock at a point of abrupt change in direction of curve. Insert the saw blade through the drilled hole and secure it in place in the chuck. Proceed as in regular outside cutting.

G. Maintenance

1. Band Saw

a. Band saw blades should be kept sharp. Sharpening should be done by someone skilled in this line.

b. The saw should be maintained at a proper tension and tracking in the center of the wheels.

c. Guide blocks and thrust wheels should be properly adjusted so that 2/3 of the width of the saw blade runs between the blocks.

d. Thrust wheels should not turn when the saw is not cutting.

e. Broken saw blades can be brazed. This should be done by experienced persons.

f. Some band saws require periodic greasing while others have sealed bearings.

g. When a band saw is to be left idle for a long period, machined parts should be coated with a thin coat of oil and the tension released on the blade.

h. Sawdust should be blown from the motor and machine after use.

i. Throat plate should be replaced when worn, to provide proper clearance for blade.

2. Jig Saw

a. All cutters should be kept sharp, in true shape, and in balance.

b. Worn table guides may be replaced to form a true edge.

c. Most machines have sealed bearings and ball bearings guides for the traverse. If a place is provided for oiling, oil periodically.

d. If left for any period of time, all machined parts should be coated with a thin film of oil to protect them from rust.

H. References

1. Teaching Woodworking to Visually Handicapped Persons. An Instructor's Guide. Department of Health, Education, and Welfare, Washington, D. C., and University of Illinois, Urbana, Illinois. 1963.

2. Woodworking Technology (Second Edition). Hammond, Donnelly, Harrod, Rayner. McKnight and McKnight Publishing Company, Bloomington, Illinois. 1961.

3. Industrial Arts Woodworking (Second Edition). John L. Feirer. Charles A. Bennett Co., Inc., Peoria, Illinois. 1965.

CHAPTER XI

PLANER AND JOINTER

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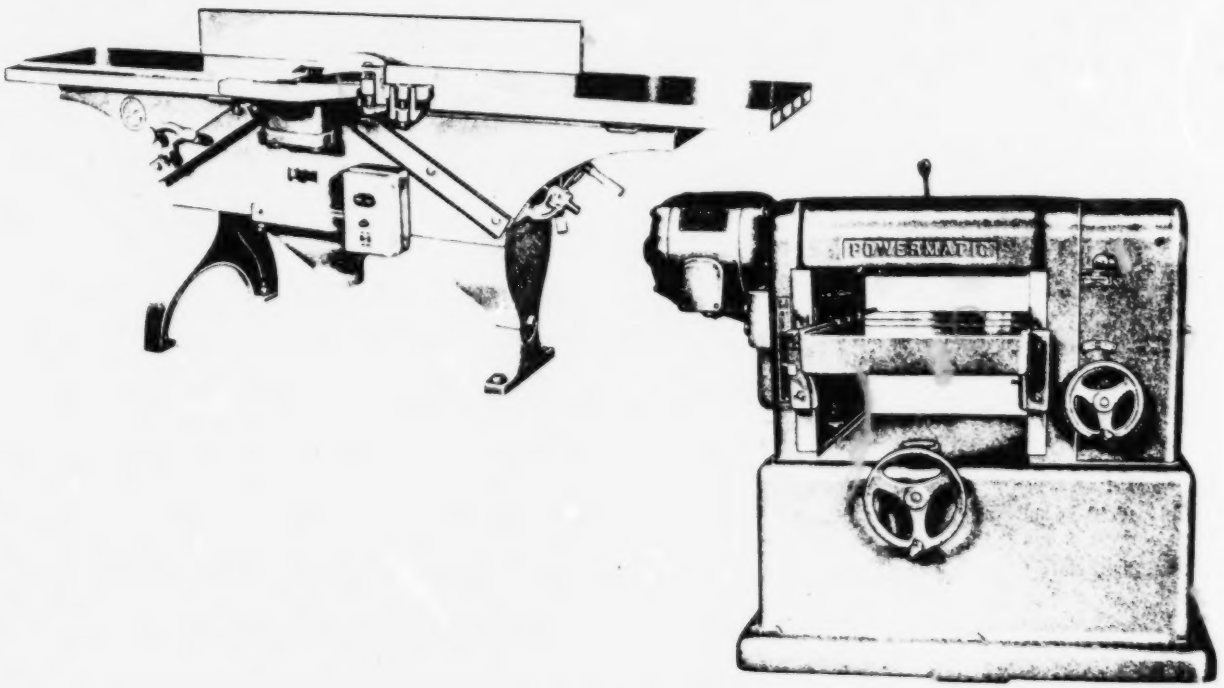

CHAPTER XI

PLANER AND JOINTER

A. Description

1. Jointer

The jointer has a round cutter head with two, three, or four knives (generally three), revolves at a speed of approximately 4,000 r.p.m., and the knives cut on the principle of a continuous set of cutting wedges. The jointer consists of an input and output table, with the cutter head positioned in the middle. It has a fence, a guard, a rear table adjustment wheel, front table adjustment wheel, and a stand. The jointer is used for planing faces and edges straight and smooth, cutting rabbets, planing tapers, chamfers, and bevels. Jointers are made in 4", 6", 8", 10", 12", 14", and 16" lathe and table widths. The wider jointers usually have longer tables, but some brands are available with extra long tables.

2. Planer or Surfacer

The planer has three full width knives which are set equally along the circumference of the cutter head which revolves at speeds ranging from 3,600 to 7,200 r.p.m. The knives cut on the principle of a continuous set of cutting wedges. The principal parts of the planer are the table, feed rolls, chip breaker, threader head, knives, back pressure bar, delivery rolls, hand wheel, loader, feed selector, and thickness gauge.

5 Safety

1 Jointer

a Boards less than ten inches long should not be planed.

b The guard should always be in position when machine is used.

c In surface jointing, a push block is recommended, especially when jointing stock which is less than 2" thick, in which case it is mandatory.

d Never run your hands directly over the cutter head.

e. Stand to one side while operating the machine.

f Be sure stock is free of nails, grit, paint, and other foreign materials.

g. Never make cuts greater than 1/16 of an inch.

2 Planer

a. Stock shorter than the distance between the feed and the delivery rolls (usually 12") should not be surfaced. Stock less than 1/4" thickness is apt to break if not supported by back board.

b. Keep hands away from the feed rolls.

c. Loose knots should be removed before the board is run through the surfacer.

d When surfacing wet or green stock, lubricate the table with kerosene or wax.

e. If stock gets stuck, shut off machine; when machine has completely stopped, lower the bed and remove the board.

f. Stand to one side of the stock when feeding or receiving.

C. Adaptations

1. Jointer

To set the jointer for the intended depth of cut, you can:

a. Check the gap between the in-feed table and the bottom of the fence. On most models this is a good indication.

b. The scale that is provided on the side of the machine can be adapted for tactual reading.

c. With the cutter stationary, a straight edge can be positioned on the out-feed table which will overhang the in-feed table the exact thickness of the cut. For bevel cuts, the fence can be set with the T-bevel and a Perkins protractor or with draftsman's triangle.

2. Planer

For checking the thickness of a board being planed, you can attach a rule that is adapted for tactual reading (such as a Stanley Caliper Rule) to the side of the machine by means of a chain or string.

D. Orientation

1. Jointer

a. Use the cross-body positioning of hands on approach for the initial point of contact on the in-feed table.

b. Because of the level of vibration and noise, state of motion of the cutters should be apparent on approach. To double check, the power switch can be bumped on and off.

c. The principal working parts to be located are: the front

table adjustment wheel, the rear table adjustment wheel, the on-off switch, and the fence. Note that the guard should be in place over the cutter at all times. When cutting is being done, the guard pivots to the side and returns when the board has passed.

d. If there is an exhaust system, the slide should be located and opened before operation.

2. Planer

a. Use a safe approach to make the initial contact at the edge of the in-feed table.

b. State of motion of the cutters should be apparent on approach due to the level of noise and vibration produced by the planer.

c. The principal parts used for adjustment and operation are: the hand wheel, used to raise and lower the blade, therefore, the cut; the feed selector, not included in all models; and the on-off switch.

d. If there is an exhaust system, it must be located and opened before operation.

E. Exceptions

1. Jointer

The front table adjustment wheel is sometimes replaced by a large nut. On these models, to set the height-depth of cut, the nut is loosened and the table is moved to the desired depth and then tightened again.

2. Planer

Some planers have a set rate of speed; on these models the feed selector wheel is eliminated.

F. Operations

1. Jointer

a. Make a safe approach to the machine for the initial contact at the edge of the in-feed table.

b. Set the desired thickness of cut. (It is suggested that a light cut be made first so that the direction of grain may be read.) Always cut with the grain.

c. Adjust the fence so that it is at right angles to the table. This may be done by using a square position on the table and against the fence.

d. Be certain that all guards are in position.

e. Position your hands so that your thumb is on top of the board and your fingers trail along the top of the fence.

f. Start the machine, standing to one side. Hold the true face of the board against the fence with the grain running down and to the rear; push the edge of the board over the cutter with a slow even motion. Be sure that enough downward pressure is applied to keep the board flush on the table.

g. If the stock has a high spot or an uneven edge, it will need to be passed over the cutter several times to remove the high spot and true the edge.

h. When planing the surface of a board, always use a push shoe.

i. Care should be taken to distribute hold down pressure evenly across the width of the board.

2. Planer

a. Make a safe approach to the machine with the initial contact at the edge of the in-feed table.

b. To set the table for the desired thickness of cut, lay the board on the in-feed table and run the hand wheel down until the board will slide in easily. Pull the board out and turn the hand wheel up two turns. Note: On most surfaces one complete revolution of the hand wheel in a clockwise direction will raise the bed 1/16 of an inch.

c. If the direction of the grain cannot be readily established, make a light cut in the planer and then feel the edge with your fingers to establish direction of grain.

d. Check that you have a clear path around the planer so that when you feed the board in you may support it as it comes out. Never allow a board to drop on the floor; long boards should be supported at each end.

e. Run the stock through as many times as necessary to reduce to the desired thickness. Turn the hand wheel one revolution clockwise in between cuts. When you have planed to a parallel thickness, successive cuts should be taken off alternate sides. To do this, stock must be turned end for end so that planing will always be with the grain.

G. Maintenance

1. Jointer

Jointers may vibrate out of adjustment from continuous use. The back table should be set the same height as the cutting edge of the knives when they are at the highest point. Some jointers are equipped with sealed bearings while others may require greasing periodically. Whenever a jointer is to be left idle for a long period of time, all machine parts should be coated with a thin coat of oil. All sharpening operations of the cutter head should be done only by an experienced person.

2. Planer

Feed rolls, chip breaker, and back pressure bar should be kept free from pitch. They may be cleaned with an alcohol rag with the power disconnected. All sharpening should be done by an experienced person. Surfacers should be periodically greased. See manufacturer's specifications for SAE number of grease to use. All adjustments for the rolls, chip breaker, and back pressure bar, should be kept according to manufacturer's recommendations.

H. References

1. Teaching Woodworking to Visually Handicapped Persons. An Instructor's Guide. Department of Health, Education, and Welfare, Washington, D. C., and University of Illinois, Urbana, Illinois. 1963.

2. Woodworking Technology (Second Edition). Hammond, Donnelly, Harrod, Rayner. Bloomington, Illinois. McKnight and McKnight Publishing Co. 1961.

3. Industrial Arts Woodworking (Second Edition). John L. Feirer, Peoria, Illinois. Charles A. Bennett Co., Inc. 1965.

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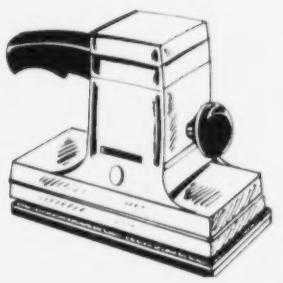

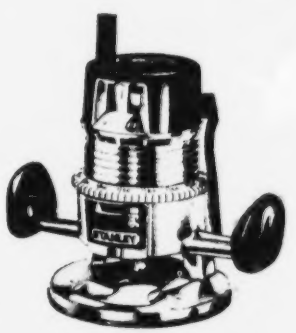

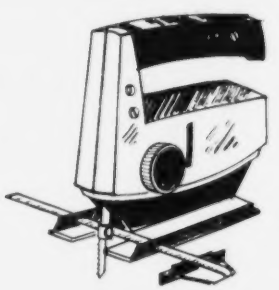

CHAPTER XII

ELECTRIC HAND TOOLS

Portable Electric Hand Drill

A. Description

The portable electric drill operates from a small, high speed electric motor with a gear reduction driving unit. The motor and gear reduction unit are encased in a housing made of aluminum or plastic. The handle is equipped with a trigger switch that supplies the power through the motor and gear reduction unit to the three-jaw hardened carbon chuck.

B. Sizes

The maximum opening of the chuck is what indicates the size of the drill. The most common drill is the 1/4". Other sizes used often are 3/8" and 1/2".

C. Safety

One of the main safety factors in using a drill is to have the drill grounded by means of a three-prong plug. Conductor cords should be handled so as not to cause wear or breaks in the cable.

D. Adaptations

The major problem that is encountered is keeping the drill bit

at the proper angle to the work. For most jobs this angle is not critical and you can guess at the angle closely by grasping the bit where it contacts the work. Where greater accuracy is needed, some sort of guide should be used. One of the simplest guides for keeping the drill at right angles to the work is to use a spool with the hole drilled to the size being used. A guide block can be made by using the drill press and drilling a number of different size holes in a hardwood block. A more permanent jig may be made out of a piece of 1"x1"x8" steel which has the standard size holes drilled in it.

E. Maintenance

The jaws of the chuck should be cleaned and lightly oiled for good operation. Portable electric drill should be stored and used in a dry place. The maintenance procedure of wrapping the cord tightly around the drill after use should be avoided.

Electric Portable Sander

A. Description

1. On a belt sander, a coated abrasive belt is run over a pad guided by an idler and driving pulley.
2. The disc sander has a coated abrasive disc which is mounted to a flat rubber disc which rotates on a motor spindle.
3. With the finish sanders, a coated abrasive strip which is fitted over a pressure pad is powered in an orbital or an in-line oscillating motion.

B. Uses

1. The belt sander is used to do flush or regular sanding. Various grit belts are available in width and length to fit a specific make of machine. Sizes of belts range in widths from 2" to 4" and lengths from 21" to 24". The belt sander needs to be used with much care and regulation, because the belt removes material rapidly and can ruin a project by "digging in" in a short amount of time.
2. The disc sander is used in rough sanding for fast removal of stock and where a scratched free surface is not a requisite. A pad may be fitted over the disc enabling it to be used in a polishing operation.
3. Finish sanders are classed according to their sanding motion.
   a. Orbital motion sander, used in finish sanding, has a fast, circular pattern. It performs the hand sanding operation on flat surfaces by its rapid action.
   b. The in-line sander's cutting action is back and forth in a straight line. This is ideal for final sanding of wood surfaces. It leaves no sanding marks on the surface as produced by the orbital sander.

C. Safety

1. Good grounding is essential in any portable machine, as this eliminates most chances of shocks caused by shorts or breaks in the wire.
2. All portable equipment should be operated in a dry place.

3. Avoid placing moist hands on machine housings.
4. All work should be secured with a vise or clamp to free the hands to operate the machine.
5. The electrical cord should be positioned so that it does not interfere with the sanding operation.

D. Adaptations

No adaptations are needed for non-visual sanding operations.

E. Maintenance

1. All worn or torn sandpapers should be replaced.
2. Most bearings are the self-lubricating type but the level of oil reserve on belt sanders must be maintained.
3. Pressure pads must be kept in working condition in order to sand efficiently.
4. Care should be used in handling the conductor cord when storing in order to avoid cable breaks.

Portable Hand Router

A. Description

In the router, cutters revolve at a spindle speed of 5,000 to 18,000 r.p.m., shaping work on the principle of a continuous set of cutting wedges. All attachments are mounted on the end of the motor's spindle. The size of the router is determined by the horsepower of the motor and the diameter of the cutter shaft. The router is used to cut mouldings, rout, cut gains for inlays, and cut dadoes and dovetails.

B. Safety

1. Safety goggles should be worn in using the router.
2. Keep your fingers and clothing away from the revolving cutters.
3. Be sure the bit is held tightly in the chuck.
4. Operate only in a dry place with the electrical cord grounded.

C. Adaptations

Because of the nature of the router, all non-visual operation is done with the use of jigs and guides.

1. For cutting dadoes and rabbets, a straight gauge may be used. A straight edge clamped to the work often provides a good guide for cutting dadoes and rabbets.
2. Templets are available for cutting gains for hinges.
3. With moulding, always use a cutter that is provided with a pilot to limit the depth of cut.
4. To cut dovetails with a router requires a dovetail fixture, guide tip, and dovetail bit.

D. Maintenance

Router cutters should be kept sharp. Sharpening should be done by an experienced person.

Some routers require periodic oiling; others have sealed bearings.

Portable Electric Saber Saw

A. Description

The portable electric saber saw is driven by the high speed electric motor and has a mechanism for changing rotary to reciprocate motion. Cutting is done on the up stroke. The most common saber saws accommodate a blade 2-1/4" to 2-3/4" long, with a length of stroke of 7/16 of an inch to 5/8 of an inch. It has a reciprocating speed of 3,000 to 4,500 strokes per minute.

B. Safety

1. Operate only in a dry place with a cord grounded.
2. Use only sharp blades, and do not force them to cut faster than will easily be used.
3. Clamp the work securely so that the cut is not interfered with.

C. Use

1. Mount a blade that is appropriate for the type of work being cut.
2. When following a curved line be sure that the line is scribed deeply.
3. Make relief cuts in the waste stock whenever possible.
4. Use a guide with ripping, cross cutting, or miter cutting.

D. Adaptations

No adaptations are needed for non-visual operation of the saber saw.

E. Maintenance

1. The conductor cord should be handled carefully to prevent wear and cable breaks.
2. The chuck should be cleaned of sawdust.
3. Lightly oil the shaft where it goes in and out of the housing.

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SANDING THE PROJECT

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CHAPTER XIII

SANDING THE PROJECT

The importance of sanding the project thoroughly should not be underemphasized. If a careful job is done, it can make the difference between a well- or a poorly finished project.

There are three things to remember in doing an efficient job of sanding. First: the stock should be held securely so that it will not move during its sanding operation. Second: the learner should explore the area to be sanded to be sure that he knows the grain direction and the boundaries of the area to be sanded. Third: the sanding stroke should be in a straight line parallel to the grain direction and extending to, but not past, the boundaries of the surface to be sanded. This last guide is important because the contour of the stock being sanded must be maintained. Perhaps the most important precaution is to avoid rounding arris.

If the tool work has been well done, medium sandpaper will be coarse enough for the first sanding. If a stain is to be used or a fine finish is desired, the work should be dampened with a cloth and allowed to dry in between sandings. This will raise the wood fibers that have been sanded down, and make them easier to sand off.

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FINISHING THE PROJECT

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CHAPTER XIV

FINISHING THE PROJECT

A. Stains

The only type of stain that is suggested for non-visual application is the oil stain. The reason being that in water stain the application has to be even and the more that it is gone over, the darker it becomes. Oil stains can be applied with a rag or sponge and the only problem would be that of covering the area fully. Once the oil stain has been applied, you need merely wait a couple minutes and then wipe off the rag with a clean soft cloth such as cheese cloth. If the application is done with a systematic motion, and in more than one direction, the job will turn out even.

B. Wood Fillers

The easiest way to apply a wood filler to open grain woods is to dip into the can with your fingers and then work it into the wood with the palm of your hand. When the wood filler loses its slippery feeling (usually from 2 to 7 minutes), then it is time to rub off the excess filler. Not more than one to three square feet should be covered at any one time, for if the filler becomes too dry, the excess is extremely difficult to remove.

A combination of oil stain and wood filler can be applied successfully to eliminate the extra finishing step. Commercially prepared colored fillers can be used to eliminate the mixing of stain and filler.

C. Finishes

1. Paints

If it is decided that the natural beauty of the wood needs to be covered, then one can use a paint. Although a brush can produce a smooth, even finish, it is suggested that you use a sponge to apply the paint; for the simple fact that the closer your hand is to the work, the more control you have over the coverage and the evenness of the paint. You must have a good supply of paint thinner for clean up, because it is necessary to "get into it" so to speak, to be assured of good coverage. If a rag is soaked in thinner before the operation is begun, then clean up need not be so messy.

2. Varnish

The approximate amount of varnish should be poured into a container and mixed with about 25% turpentine for the first coat. Again a sponge or brush can be used for anplying the finish. The varnish is flowed onto the surface in the direction of the grain, brushed out across the grain and finished with the grain using light, full length strokes. Use turpentine for clean up. Polyurethane varnish is a very tough, hard, flexible finish which has a superior resistance to chipping, abrasion, and dirt retention. It can be used with good success if applied with care. Clean up and thinning is done with paint thinner. If a light sanding with 600 grit sand paper is done in between coats, a finer finish will be obtained.

3. Wax

Regular furniture or floor wax of the paste variety may also be used as wood finish and certainly would be one of the easiest finishes to apply. Two or three coats of wax are applied with a lint-free rag and rubbed into the wood.